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Asai et al.

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(54) **SUBSTRATE PROCESSING SYSTEM, GROUP MANAGING APPARATUS, AND METHOD OF ANALYZING ABNORMAL STATE**

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**
G06F 19/00 (2011.01)

(52) **U.S. Cl.**
USPC **700/98**; 700/121; 438/10

(58) **Field of Classification Search**
USPC 700/98, 117–121, 108–110, 296; 438/10; 702/187; 118/696
See application file for complete search history.

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(57) **ABSTRACT**

A maintenance engineer can analyze an abnormal state with less difficulty in a rapid and correct manner independent of his/her skill. A substrate processing system comprises: a substrate processing apparatus configured to operate according to a recipe defining a process sequence and process conditions, and a group managing apparatus connected to the substrate processing apparatus. The group managing apparatus comprises an analysis support unit. The analysis support unit is configured to extract check item information relating to both abnormal state information for indentifying an abnormal state occurring when the recipe is executed and apparatus type information for identifying the type of the substrate processing apparatus at which the abnormal state occurs, and to prepare a check item table comprising the extracted check item information.

11 Claims, 11 Drawing Sheets

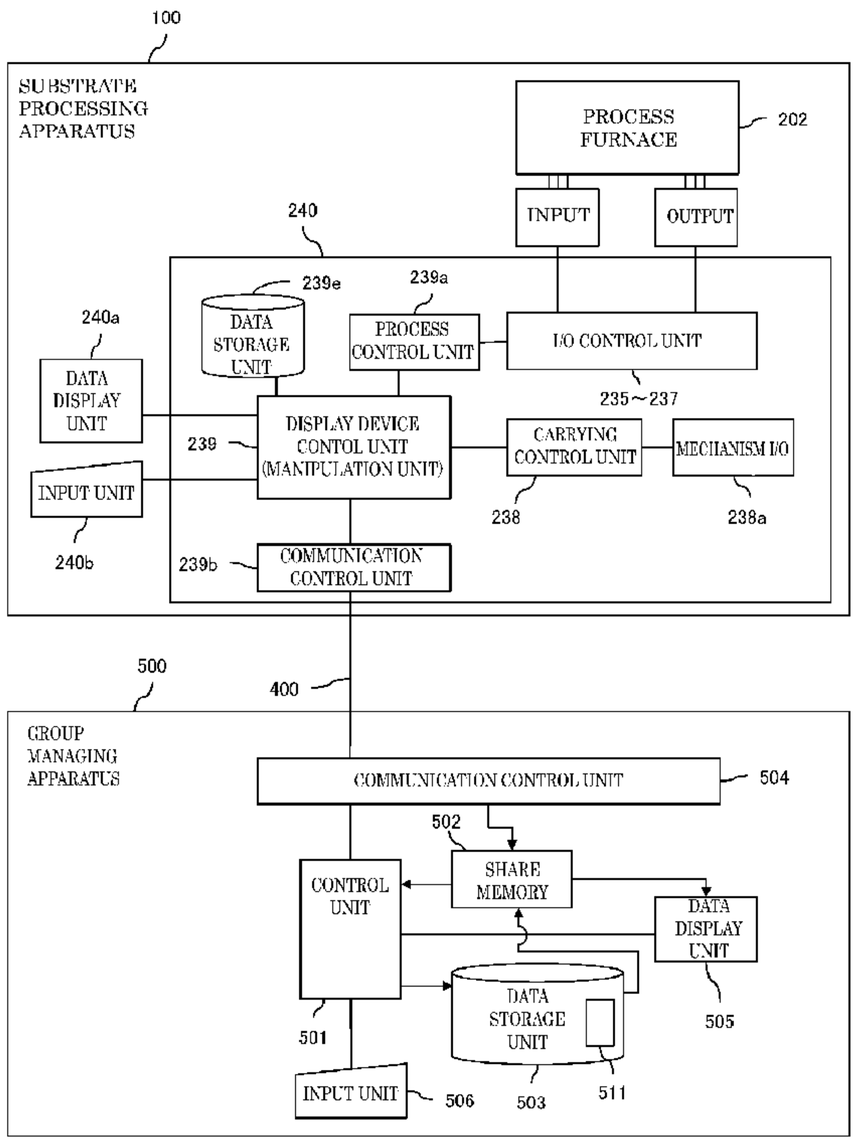


Fig. 1

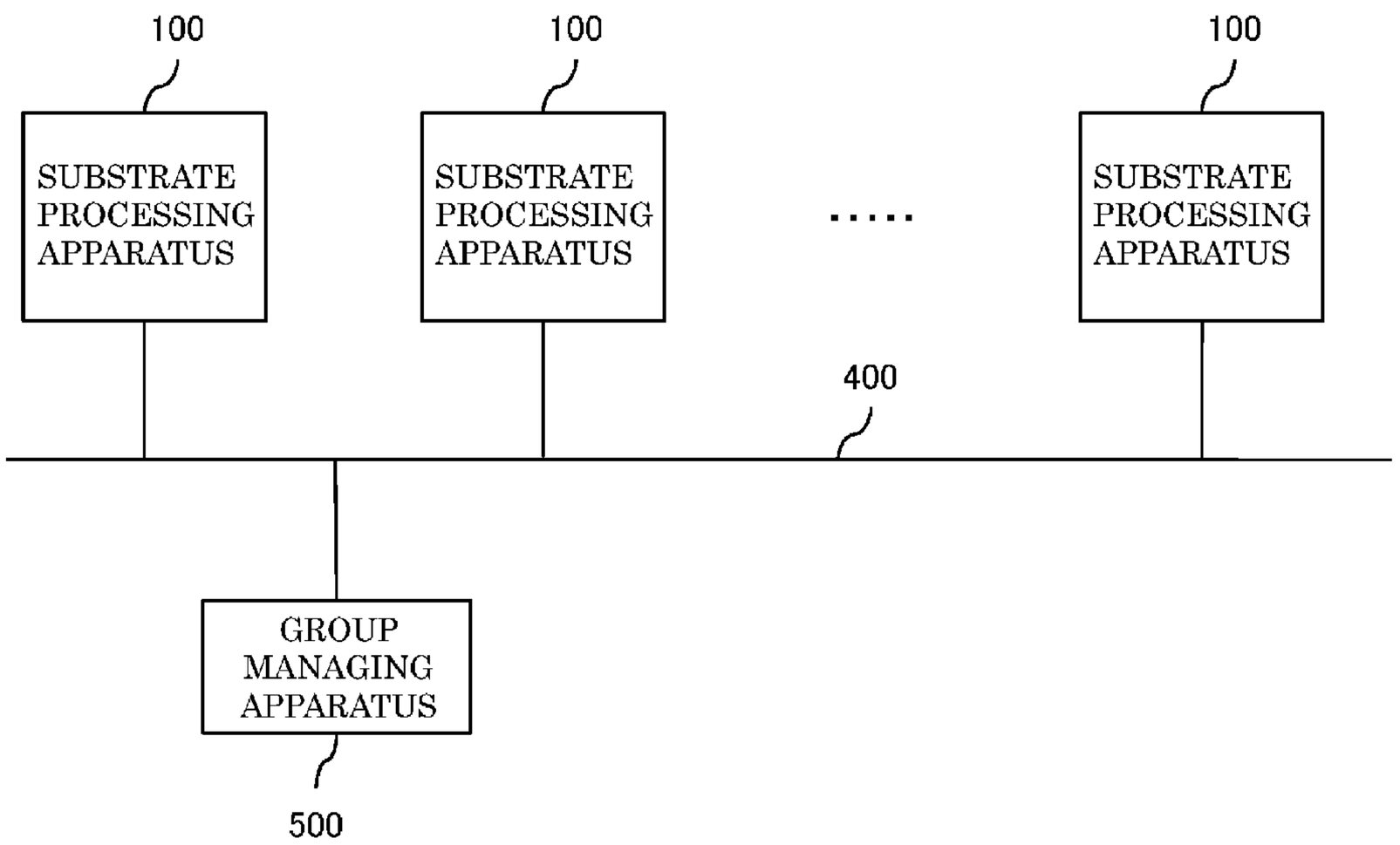

100
100
100
SUBSTRATE PROCESSING APPARATUS
SUBSTRATE PROCESSING APPARATUS
SUBSTRATE PROCESSING APPARATUS
400
GROUP MANAGING APPARATUS
500

Fig. 2

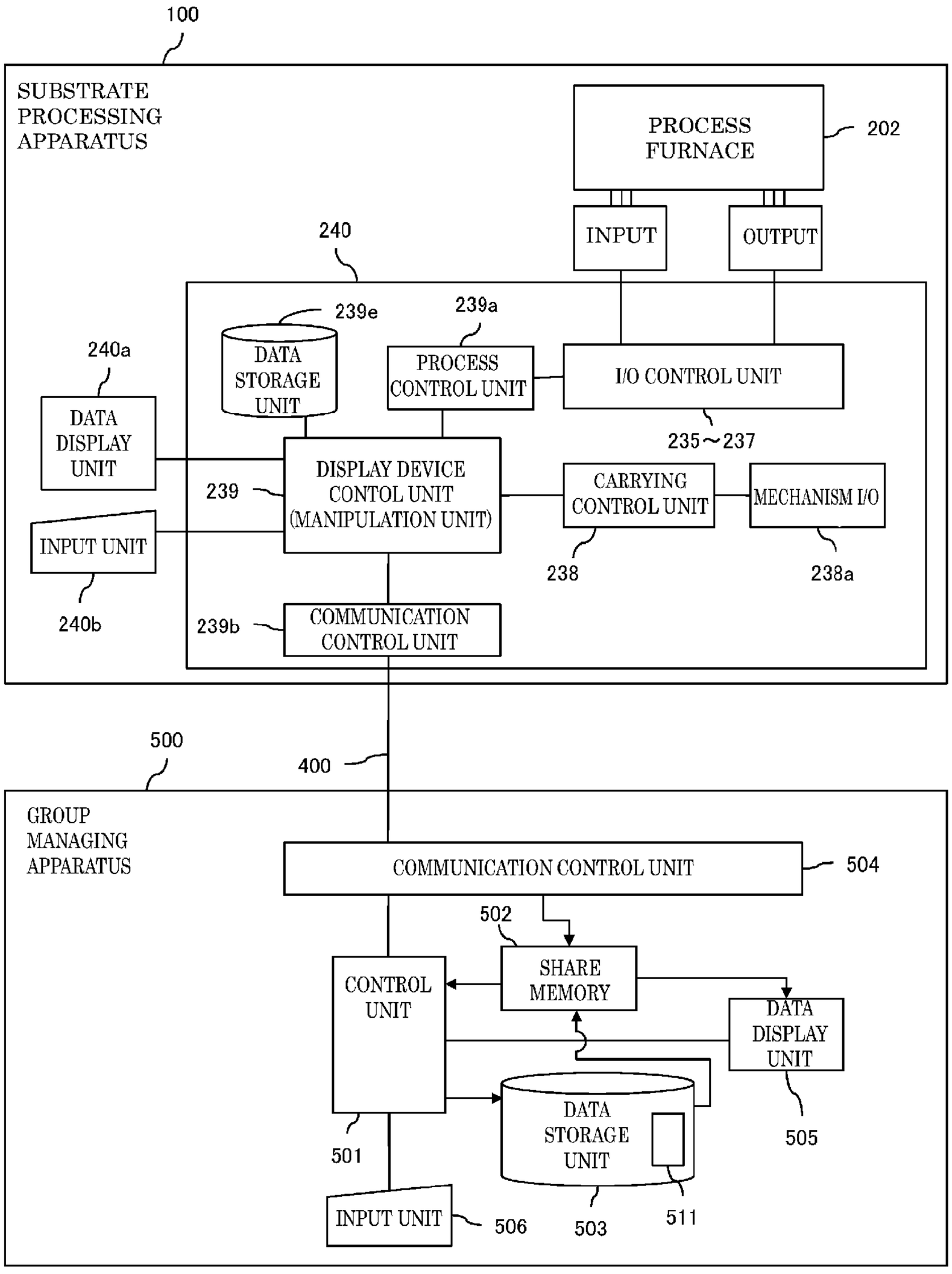

100
SUBSTRATE PROCESSING APPARATUS
PROCESS FURNACE
202
INPUT
OUTPUT
240
239e
239a
DATA STORAGE UNIT
PROCESS CONTROL UNIT
I/O CONTROL UNIT
240a
DATA DISPLAY UNIT
235～237
239
DISPLAY DEVICE CONTOL UNIT (MANIPULATION UNIT)
CARRYING CONTROL UNIT
MECHANISM I/O
INPUT UNIT
238
238a
240b
239b
COMMUNICATION CONTROL UNIT
500
400
GROUP MANAGING APPARATUS
COMMUNICATION CONTROL UNIT
504
502
SHARE MEMORY
CONTROL UNIT
DATA DISPLAY UNIT
DATA STORAGE UNIT
505
501
INPUT UNIT
506
503
511

Fig. 3

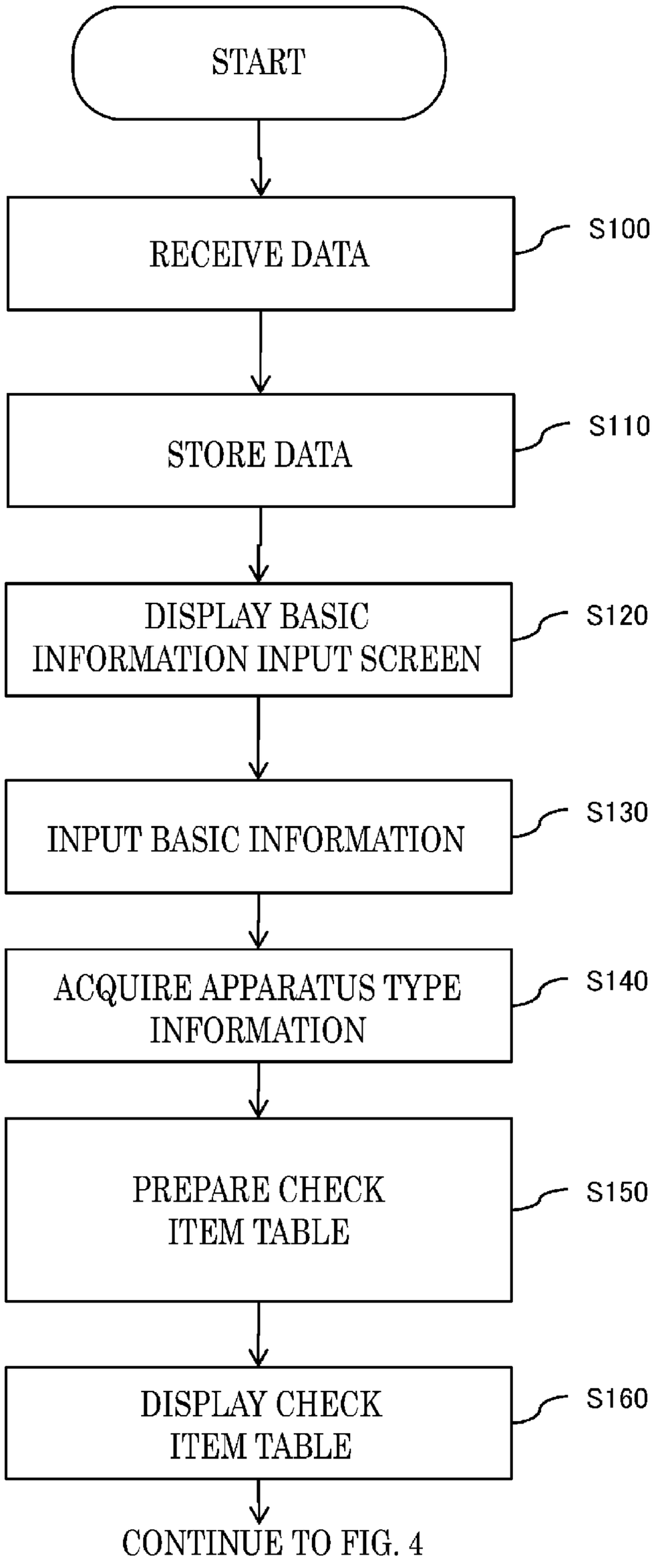

START
RECEIVE DATA
S100
STORE DATA
S110
DISPLAY BASIC INFORMATION INPUT SCREEN
S120
INPUT BASIC INFORMATION
S130
ACQUIRE APPARATUS TYPE INFORMATION
S140
PREPARE CHECK ITEM TABLE
S150
DISPLAY CHECK ITEM TABLE
S160
CONTINUE TO FIG. 4

Fig. 4

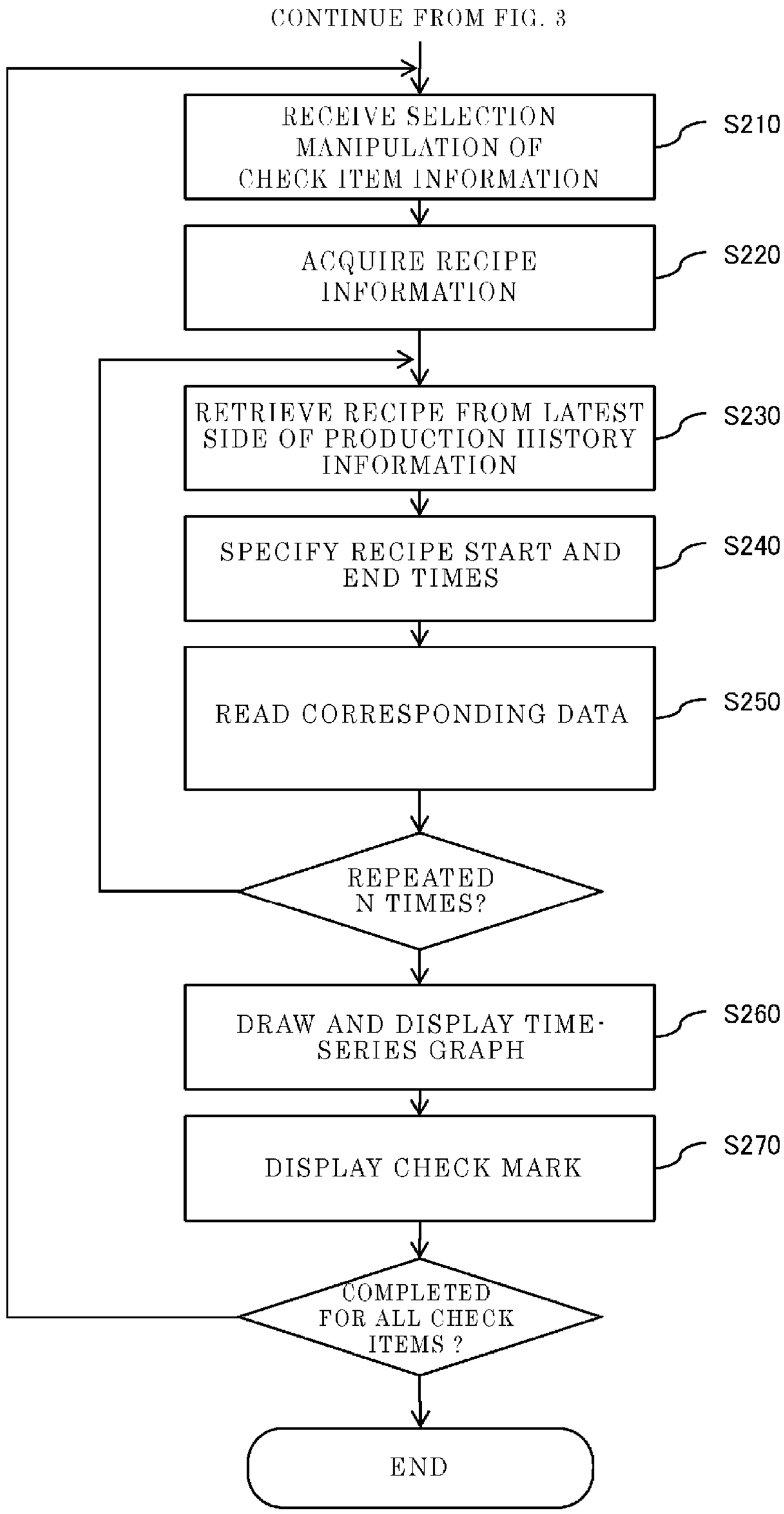

CONTINUE FROM FIG. 3
RECEIVE SELECTION MANIPULATION OF CHECK ITEM INFORMATION
S210
ACQUIRE RECIPE INFORMATION
S220
RETRIEVE RECIPE FROM LATEST SIDE OF PRODUCTION HISTORY INFORMATION
S230
SPECIFY RECIPE START AND END TIMES
S240
READ CORRESPONDING DATA
S250
REPEATED N TIMES?
DRAW AND DISPLAY TIME-SERIES GRAPH
S260
DISPLAY CHECK MARK
S270
COMPLETED FOR ALL CHECK ITEMS ?
END

Fig. 5

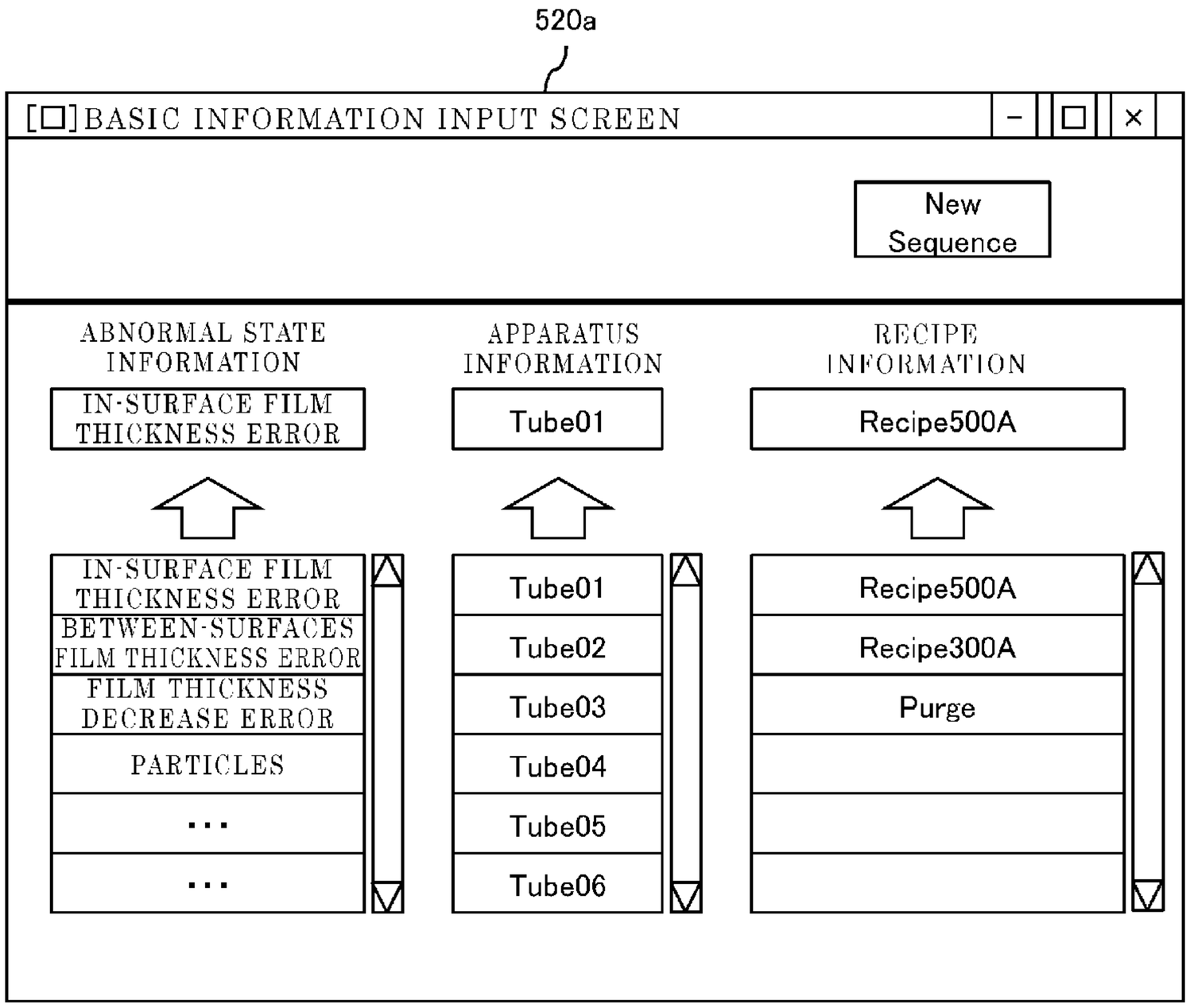

520a
[□]BASIC INFORMATION INPUT SCREEN
New Sequence
ABNORMAL STATE INFORMATION
APPARATUS INFORMATION
RECIPE INFORMATION
IN-SURFACE FILM THICKNESS ERROR
Tube01
Recipe500A
IN-SURFACE FILM THICKNESS ERROR
BETWEEN-SURFACES FILM THICKNESS ERROR
FILM THICKNESS DECREASE ERROR
PARTICLES
...
...
Tube01
Tube02
Tube03
Tube04
Tube05
Tube06
Recipe500A
Recipe300A
Purge

Fig. 6

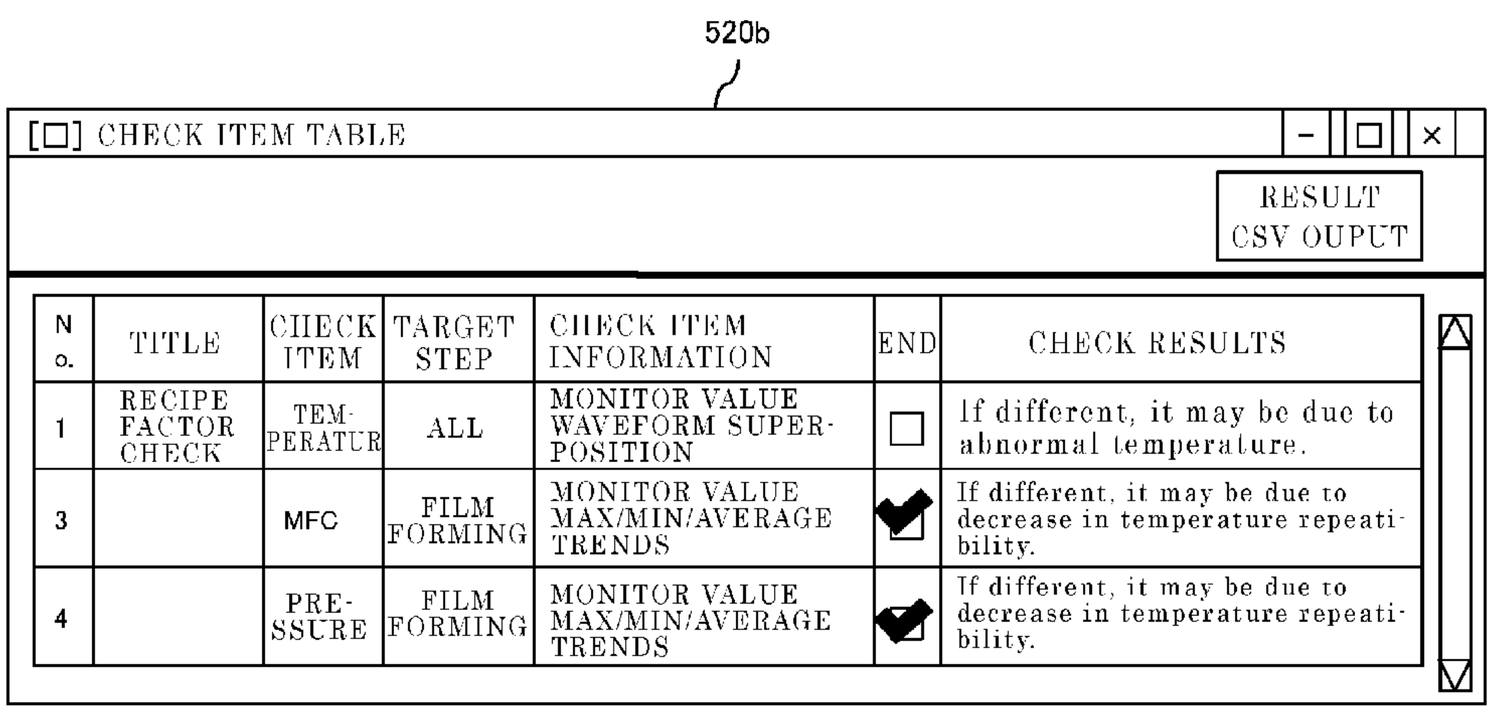

520b
[□] CHECK ITEM TABLE
RESULT CSV OUPUT
No.
TITLE
CHECK ITEM
TARGET STEP
CHECK ITEM INFORMATION
END
CHECK RESULTS
1
RECIPE FACTOR CHECK
TEM-PERATUR
ALL
MONITOR VALUE WAVEFORM SUPER-POSITION
If different, it may be due to abnormal temperature.
3
MFC
FILM FORMING
MONITOR VALUE MAX/MIN/AVERAGE TRENDS
If different, it may be due to decrease in temperature repeatibility.
4
PRE-SSURE
FILM FORMING
MONITOR VALUE MAX/MIN/AVERAGE TRENDS
If different, it may be due to decrease in temperature repeatibility.

Fig. 7

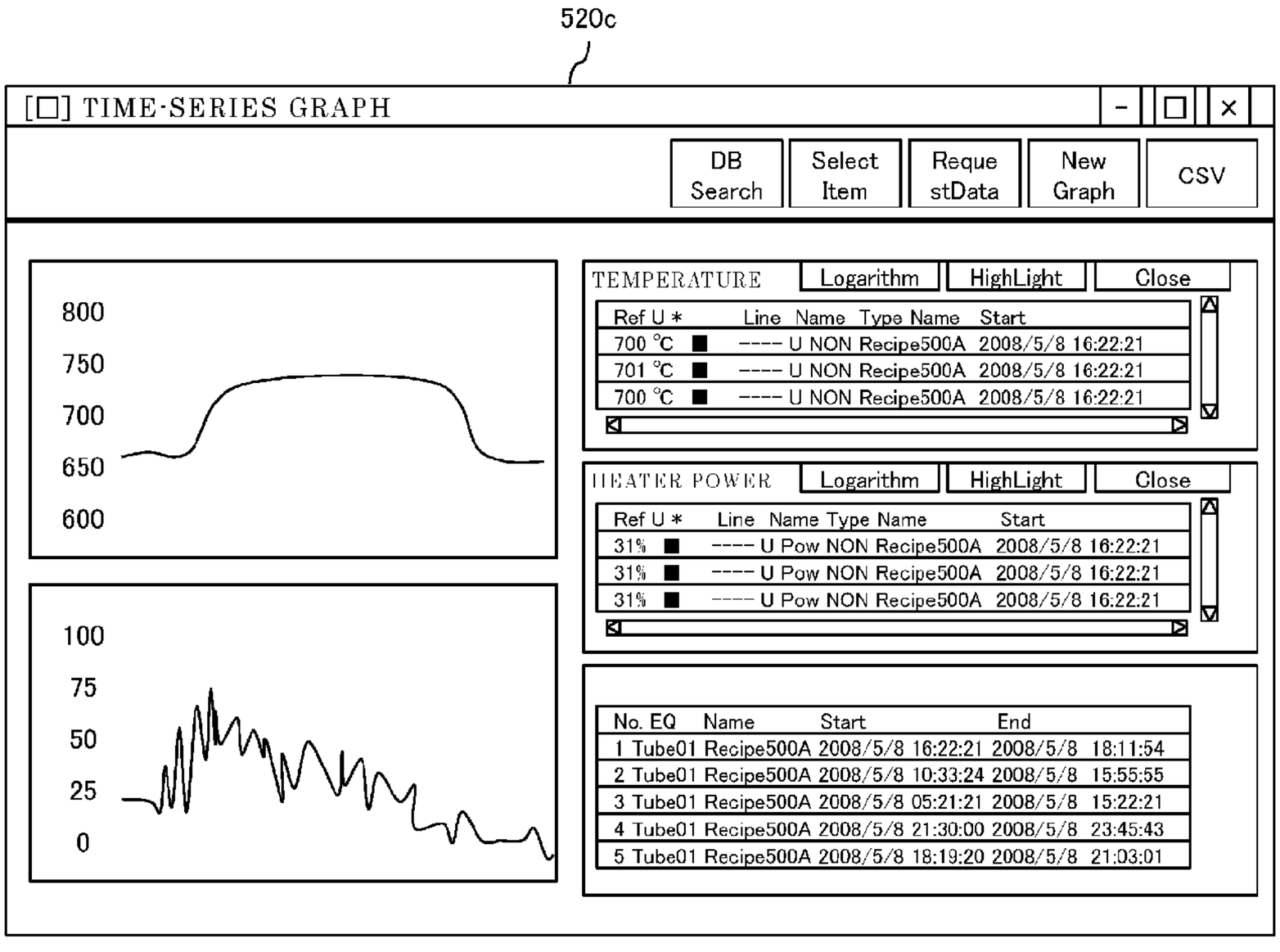

520c
[□] TIME-SERIES GRAPH
DB Search
Select Item
Reque stData
New Graph
CSV
800
750
700
650
600
100
75
50
25
0
TEMPERATURE
Logarithm
HighLight
Close
Ref U * Line Name Type Name Start
700 °C ---- U NON Recipe500A 2008/5/8 16:22:21
701 °C ---- U NON Recipe500A 2008/5/8 16:22:21
700 °C ---- U NON Recipe500A 2008/5/8 16:22:21
HEATER POWER
Logarithm
HighLight
Close
Ref U * Line Name Type Name Start
31% ---- U Pow NON Recipe500A 2008/5/8 16:22:21
31% ---- U Pow NON Recipe500A 2008/5/8 16:22:21
31% ---- U Pow NON Recipe500A 2008/5/8 16:22:21
No. EQ Name Start End
1 Tube01 Recipe500A 2008/5/8 16:22:21 2008/5/8 18:11:54
2 Tube01 Recipe500A 2008/5/8 10:33:24 2008/5/8 15:55:55
3 Tube01 Recipe500A 2008/5/8 05:21:21 2008/5/8 15:22:21
4 Tube01 Recipe500A 2008/5/8 21:30:00 2008/5/8 23:45:43
5 Tube01 Recipe500A 2008/5/8 18:19:20 2008/5/8 21:03:01

Fig. 8

503a

ABNORMAL STATE ANALYSIS INFORMATION TABLE

No.	TITLE	CHECK ITEMS	ABNORMAL STATE INFORMATION				APPARATUS TYPE INFORMATION			CHECK ITEM INFORMATION	CHECKED
			IN-SURFACE	BETWEEN SURFACES	DEC-REASE	WASTE	DIFFU-SION	CVD	ALD		
1	RECIPE ACTOR CHECK	TEMP.	○	○		○	○	○	○	MONITOR VALUE WAVEFORM SUPERPOSITION	□
2					○		○	○	○	MONITOR VALUE AVERAGE TREND	□
3		MFC	○	○	○	○	○	○	○	MONITOR VALUE MAX/MIN/AVEAGE TRENDS	□
4		PRESSURE	○	○	○	○		○	○	MONITOR VALUE MAX/MIN/AVEAGE TRENDS	□
5		CKD OPENING	○	○		○		○	○	MONITOR VALUE WAVEFORM SUPERPOSITION	□
6			○	○				○	○	MONITOR VALUE MAX/MIN/AVEAGE TRENDS	□
7		RF	○	○					○	MONITOR VALUE WAVEFORM SUPERPOSITION (REPETITION IN BATCH)	□
8			○	○					○	TREND FROM START TO 10 SEC	□
9		OZONIZER CONTENT	○	○					○	MONITOR VALUE WAVEFORM SUPERPOSITION	□
10			○	○					○	MONITOR VALUE MAX/MIN/AVEAGE TRENDS	□

BASIC INFORMATION
ABNORMAL STATE INFORMATION 「IN-SURFACE」
APPARATUS INFORMATION 「Tube01」
RECIPE INFORMATION 「Recipe500A」

503c

APPARATUS TYPE BASED TABLE
APPARATUS INFORMATION : APPARATUS TYPE INFORMATION
「Tube01」:「CVD」
「Tube02」:「CVD」
「Tube03」:「ALD」
...

503b

ROWS MARKED WITH "O" IN BOTH ABNORMAL STATE INFORMATION AND APPARATUS TYPE INFORMATION ARE SELECTED

520b

[□] CHECK ITEM TABLE

RESULT CSV OUPUT

No.	TITLE	CHECK ITEM	TARGET STEP	CHECK ITEM INFORMATION	END	CHECK RESULTS
1	RECIPE FACTOR CHECK	TEM-PERATUR	ALL	MONITOR VALUE WAVEFORM SUPER-POSITION	□	If different, it may be due to abnormal temperature.
3		MFC	FILM FORMING	MONITOR VALUE MAX/MIN/AVERAGE TRENDS	□	If different, it may be due to decrease in temperature repeatibility.
4		PRE-SSURE	FILM FORMING	MONITOR VALUE MAX/MIN/AVERAGE TRENDS	□	If different, it may be due to decrease in temperature repeatibility.

Fig. 9

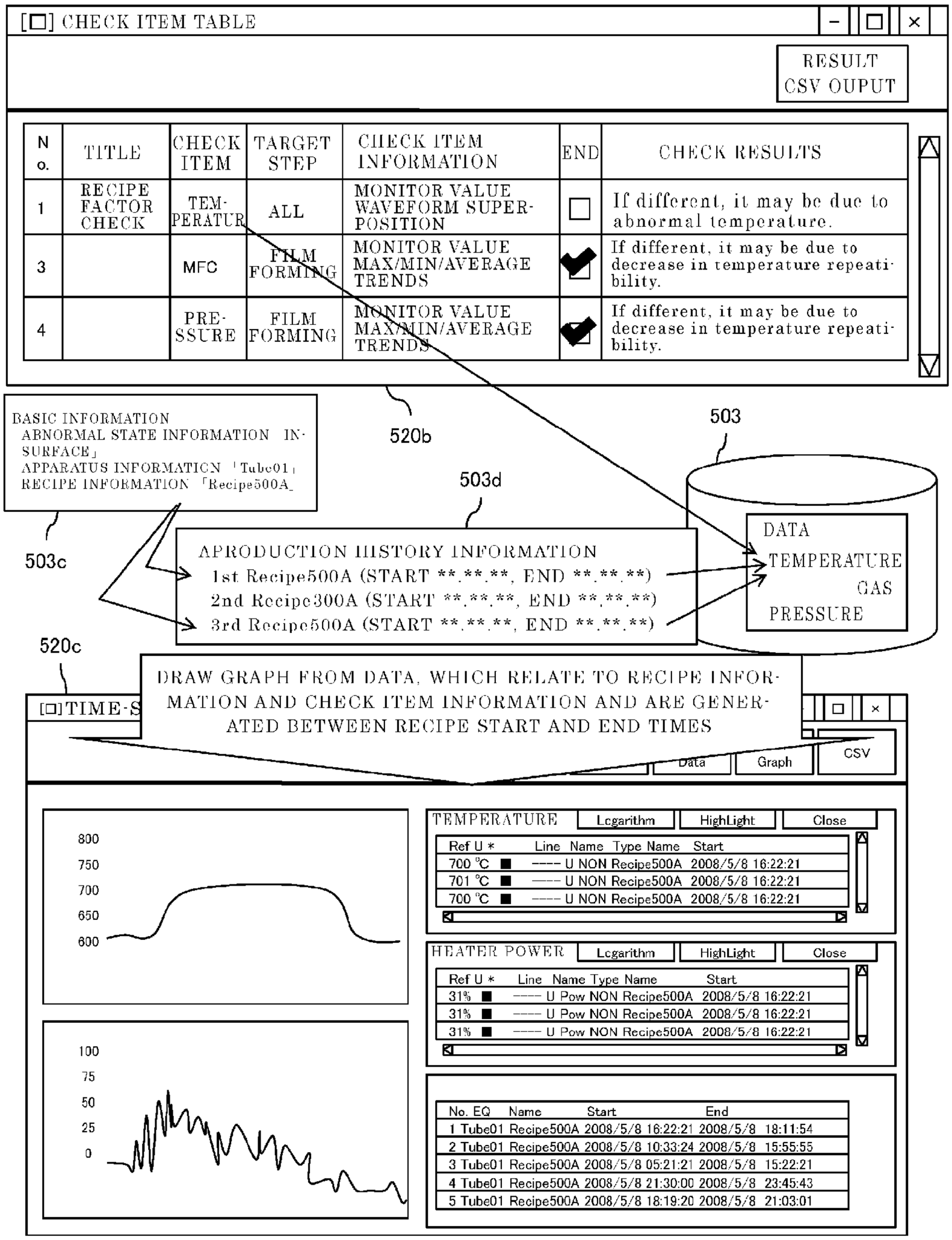

[□] CHECK ITEM TABLE
RESULT CSV OUPUT
No. | TITLE | CHECK ITEM | TARGET STEP | CHECK ITEM INFORMATION | END | CHECK RESULTS
1 | RECIPE FACTOR CHECK | TEM-PERATUR | ALL | MONITOR VALUE WAVEFORM SUPER-POSITION | ☐ | If different, it may be due to abnormal temperature.
3 | | MFC | FILM FORMING | MONITOR VALUE MAX/MIN/AVERAGE TRENDS | ☑ | If different, it may be due to decrease in temperature repeati-bility.
4 | | PRE-SSURE | FILM FORMING | MONITOR VALUE MAX/MIN/AVERAGE TRENDS | ☑ | If different, it may be due to decrease in temperature repeati-bility.
BASIC INFORMATION
ABNORMAL STATE INFORMATION IN-SURFACE」
APPARATUS INFORMATION 「Tube01」
RECIPE INFORMATION 「Recipe500A」
503c
520b
503
503d
APRODUCTION HISTORY INFORMATION
1st Recipe500A (START **.**.**, END **.**.**)
2nd Recipe300A (START **.**.**, END **.**.**)
3rd Recipe500A (START **.**.**, END **.**.**)
DATA
TEMPERATURE
GAS
PRESSURE
520c
DRAW GRAPH FROM DATA, WHICH RELATE TO RECIPE INFOR-MATION AND CHECK ITEM INFORMATION AND ARE GENER-ATED BETWEEN RECIPE START AND END TIMES
[□]TIME-S
Data
Graph
CSV
800
750
700
650
600
100
75
50
25
0
TEMPERATURE
Logarithm
HighLight
Close
Ref U * Line Name Type Name Start
700 °C ■ ---- U NON Recipe500A 2008/5/8 16:22:21
701 °C ■ ---- U NON Recipe500A 2008/5/8 16:22:21
700 °C ■ ---- U NON Recipe500A 2008/5/8 16:22:21
HEATER POWER
Logarithm
HighLight
Close
Ref U * Line Name Type Name Start
31% ■ ---- U Pow NON Recipe500A 2008/5/8 16:22:21
31% ■ ---- U Pow NON Recipe500A 2008/5/8 16:22:21
31% ■ ---- U Pow NON Recipe500A 2008/5/8 16:22:21
No. EQ Name Start End
1 Tube01 Recipe500A 2008/5/8 16:22:21 2008/5/8 18:11:54
2 Tube01 Recipe500A 2008/5/8 10:33:24 2008/5/8 15:55:55
3 Tube01 Recipe500A 2008/5/8 05:21:21 2008/5/8 15:22:21
4 Tube01 Recipe500A 2008/5/8 21:30:00 2008/5/8 23:45:43
5 Tube01 Recipe500A 2008/5/8 18:19:20 2008/5/8 21:03:01

Fig. 10

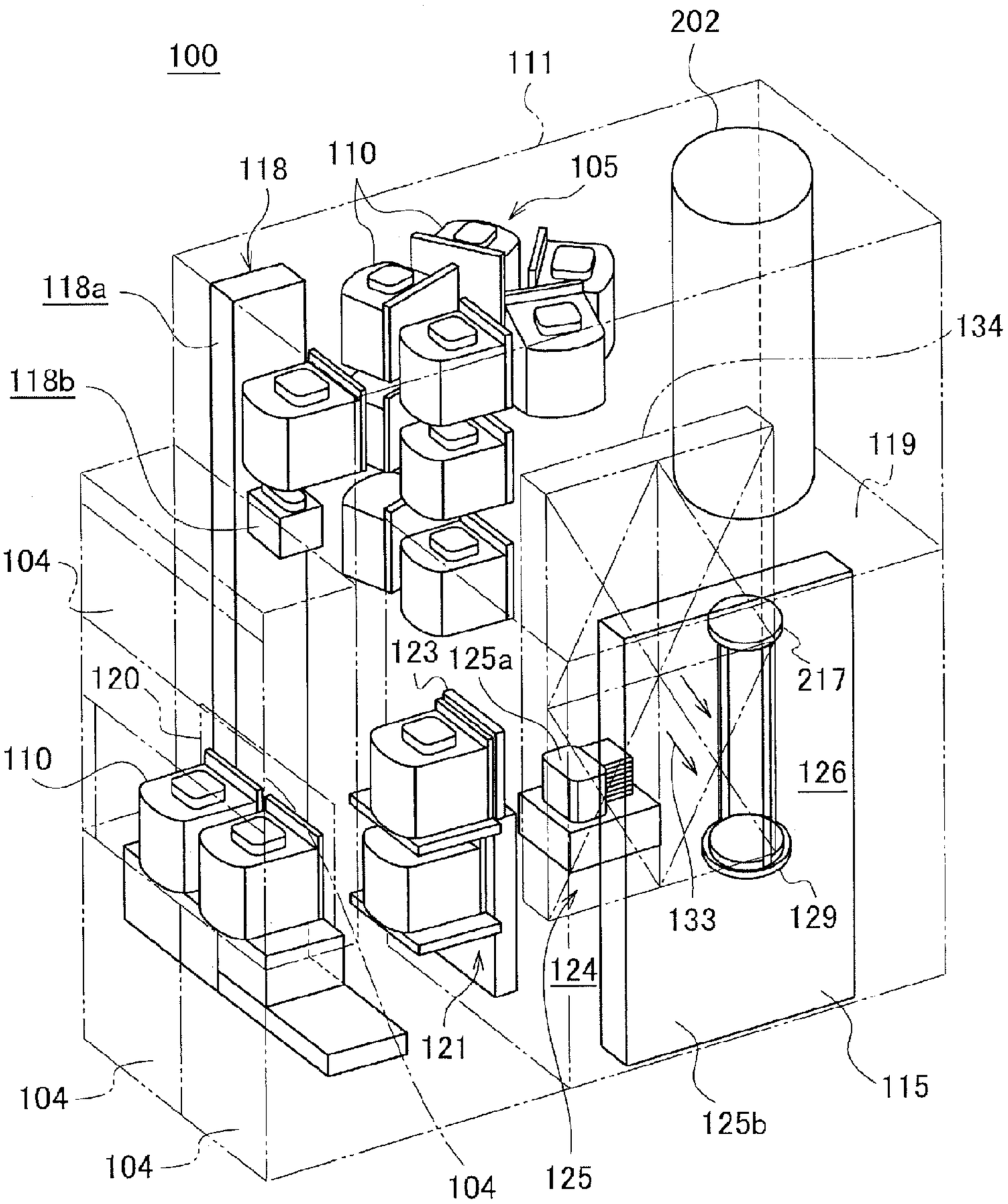

100
111
202
118
110
105
118a
134
118b
119
104
123
125a
217
120
110
126
133
129
124
121
104
104
104
125
125b
115

Fig. 11

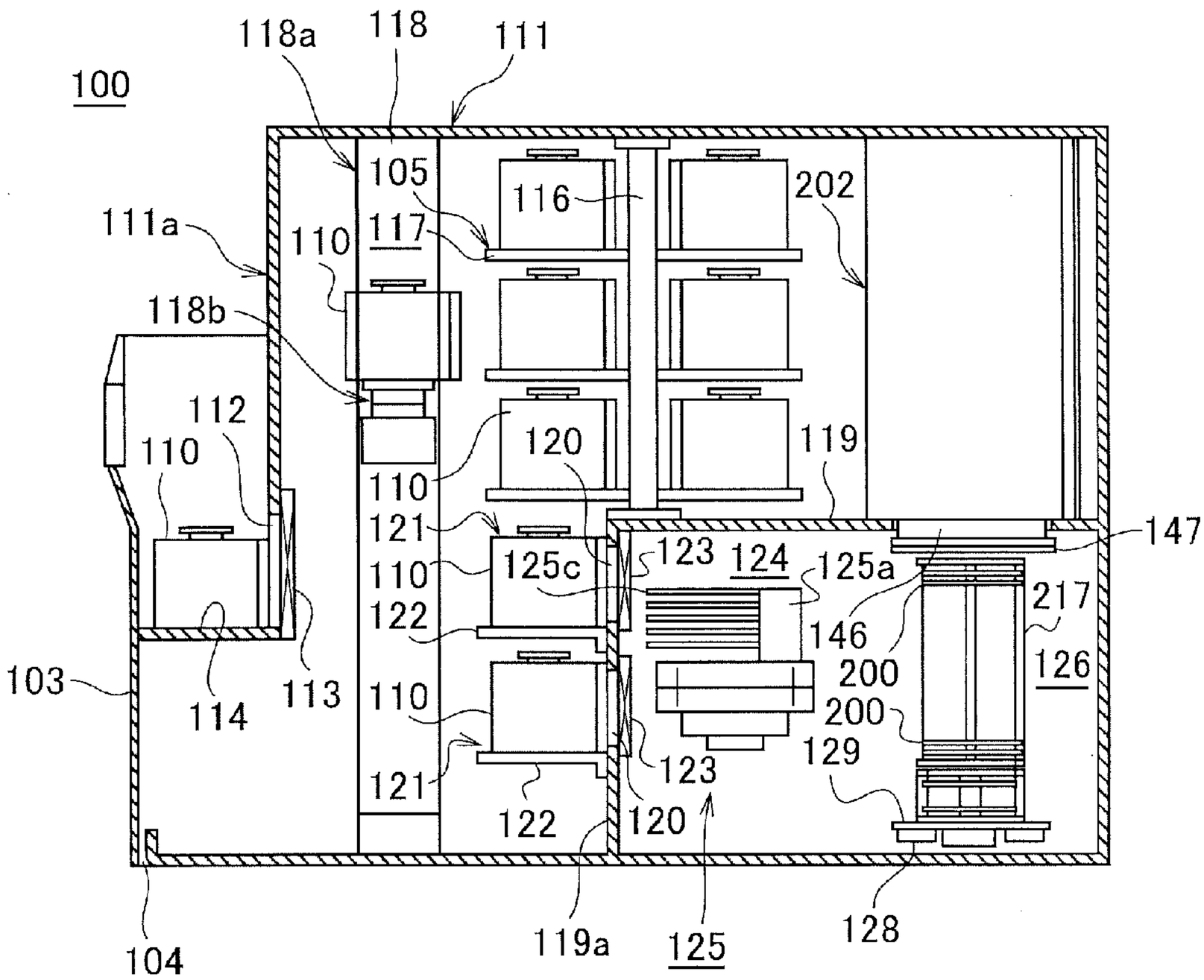
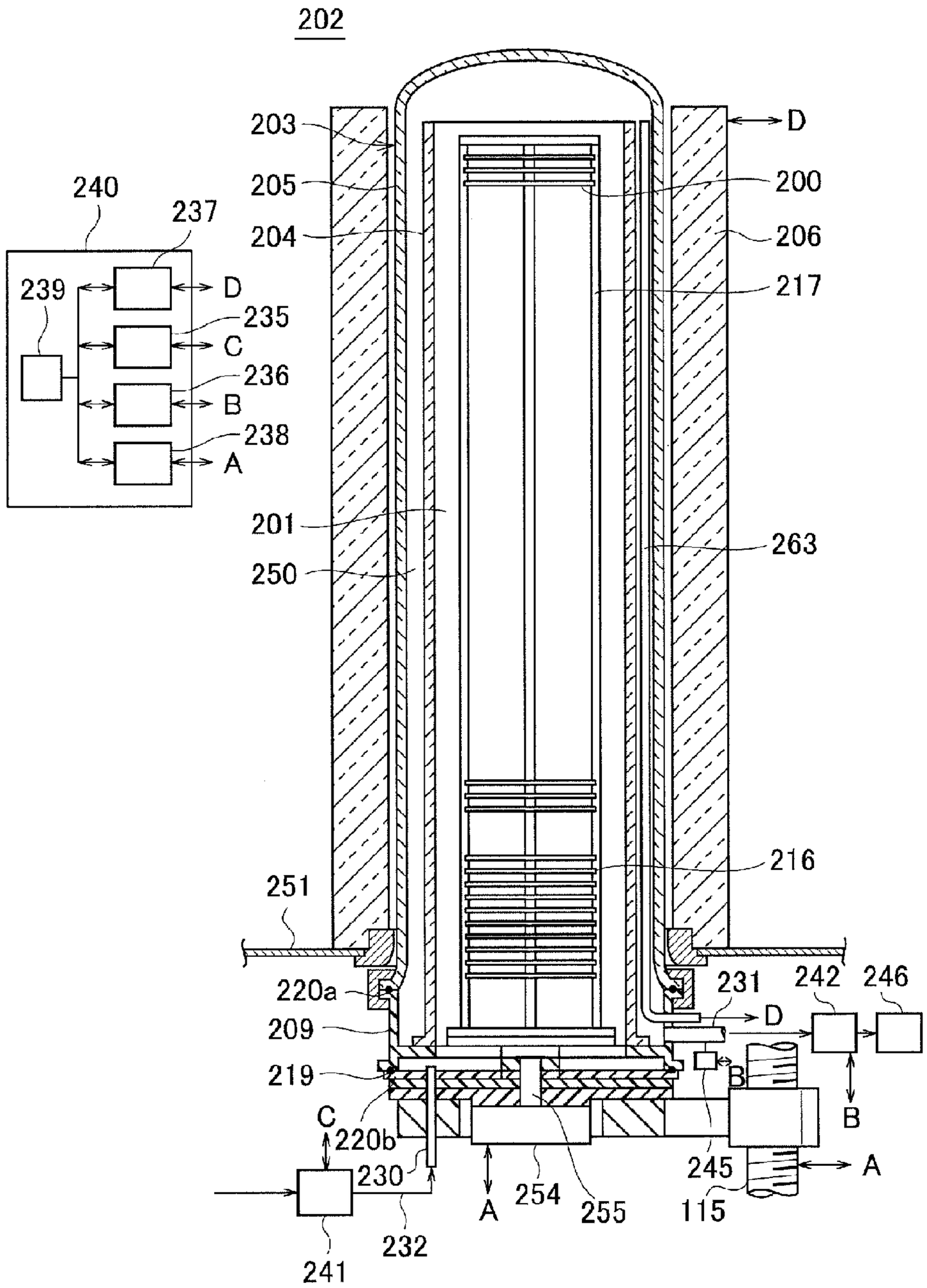

100
118a
118
111
105
116
202
111a
110
117
118b
112
110
120
119
110
121
147
123
124
125a
125c
110
122
146
217
200
126
103
114
113
110
200
129
123
121
122
120
104
119a
125
128

Fig. 12


202
203
205
204
240
237
239
D
235
C
236
B
238
A
201
250
D
200
206
217
263
216
251
220a
209
219
C
220b
230
232
241
231
242
246
D
B
B
245
A
254
255
115
A

SUBSTRATE PROCESSING SYSTEM, GROUP MANAGING APPARATUS, AND METHOD OF ANALYZING ABNORMAL STATE

CROSS-REFERENCE TO RELATED PATENT APPLICATION

This U.S. non-provisional patent application claims priority under 35 U.S.C. §119 of Japanese Patent Application No. 2009-231319, filed on Oct. 5, 2009, in the Japanese Patent Office, the entire contents of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a substrate processing system including a substrate processing apparatus operating according to a recipe defining process sequences and process conditions and a group managing apparatus connected to the substrate processing apparatus, and a method of analyzing an abnormal state of the substrate processing apparatus.

2. Description of the Related Art

In a substrate processing apparatus operating according to a recipe defining process sequences and conditions, data (for example, time-series data such as temperatures, gas mass flows, and pressures) indicating recipe progress states and states of the substrate processing apparatus are generated at a plurality of parts (such as a temperature sensor, a gas mass flow meter, and a pressure gauge; hereinafter, these parts will be referred to as data generating parts. If the recipe is abnormally executed or the state of the substrate processing apparatus is abnormal, a maintenance engineer of the substrate processing apparatus hears information such as "abnormal state information", "substrate processing apparatus information", and "abnormal state occurring time" from an user of the substrate processing apparatus, and the maintenance engineer checks data of the substrate processing apparatus based on the information so as to analyze a cause of the abnormal state (hereinafter, analysis of a cause of an abnormal state will be referred to as an abnormal state analysis).

However, since there are many candidate items to be checked, abnormal state analysis may be incorrectly carried out or it may take much time to analyze the abnormal state according to the skill of the maintenance engineer. For example, after a thin film forming recipe is executed on a substrate, if there is an abnormal state such as "decrease in the in-surface uniformity of a thin film", a plurality of check items such as the inside temperature (process temperature) of a process chamber in which the substrate is accommodated, the mass flow of gas supplied into the process chamber, and the inside pressure of the process chamber can be candidate check items. Therefore, according to the skill of the maintenance engineer, some of necessary check items may not be checked, and thus abnormal state analysis may be incorrectly conducted. In addition, according to the skill of the maintenance engineer, unnecessary items may be checked, and thus time may be wasted.

In addition, although the skill of the maintenance engineer is fairly good, it may take a long time for the maintenance engineer to collect necessary data according to check items. For example, if it is necessary to check the difference between data (for example, process temperature or pressure) of the abnormal substrate processing apparatus and data of another substrate processing apparatus, the maintenance engineer may have to collect predetermined data from the abnormal substrate processing apparatus while collecting corresponding data from the other substrate processing apparatus. Therefore, if the other substrate processing apparatus is distant from the abnormal substrate processing apparatus or it is necessary to collect a large amount of data, it may take significant time to analyze the abnormal state.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a substrate processing system an abnormal state of which can be analyzed by a maintenance engineer with less difficulty in a rapid and correct manner independent of the skill of the maintenance engineer.

According to an aspect of the present invention, there is provided substrate processing system comprising: a substrate processing apparatus configured to operate according to a recipe defining a process sequence and process conditions; and a group managing apparatus connected to the substrate processing apparatus, wherein the group managing apparatus comprises: a storage unit configured to store an apparatus type information specifying a type of the substrate processing apparatus in an abnormal state by relating to an apparatus information indicating the substrate processing apparatus in the abnormal state, and a check item information specifying a check item necessary for analyzing a cause of the abnormal state related to the apparatus type information and an abnormal state information specifying the abnormal state occurring during an execution of the recipe; and an analysis support unit configured to receive a basic information comprising the abnormal state information and the apparatus information, acquire the apparatus type information related to the apparatus information by referring to the storage unit, extract the check item information related to the apparatus type information and the abnormal state information, and prepare a check item table comprising extracted check item information.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic diagram illustrating a substrate processing system according to the embodiment of the present invention.

FIG. **2** is a block diagram illustrating a substrate processing apparatus and a group managing apparatus of the substrate processing system according to the embodiment of the present invention.

FIG. **3** is a flowchart illustrating exemplary operations of the group managing apparatus for preparing a check item table according to the embodiment of the present invention.

FIG. **4** is a flowchart illustrating exemplary operations of the group managing apparatus for preparing a time-series graph according to the embodiment of the present invention.

FIG. **5** is a schematic diagram illustrating an exemplary basic information input screen according to the embodiment of the present invention.

FIG. **6** is a schematic diagram illustrating an exemplary check item table according to the embodiment of the present invention.

FIG. **7** is a schematic diagram illustrating an exemplary screen including a time-series graph according to the embodiment of the present invention.

FIG. **8** is a schematic diagram illustrating a part of an exemplary abnormal information analysis table and a way of preparing a check item table based on basic information, tables acquired according to the kinds of apparatuses, and the abnormal information analysis table, according to the embodiment of the present invention.

FIG. **9** is a schematic diagram illustrating a way of preparing a time-series graph by receiving a manipulation of selecting check item information included in the check item table, according to the embodiment of the present invention.

FIG. **10** is a perspective diagram illustrating the substrate processing apparatus according to the embodiment of the present invention.

FIG. **11** is a side sectional diagram illustrating the substrate processing apparatus according to the embodiment of the present invention.

FIG. **12** is a vertical sectional diagram illustrating a process furnace of the substrate processing apparatus according to the embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiment of the Present Invention

Hereinafter, an embodiment of the present invention will be described.

(1) Structure of Substrate Processing System

First, with reference to FIG. **1**, an explanation will be given on substrate processing system according to an embodiment of the present invention. FIG. **1** is a schematic view illustrating a substrate processing system according to an embodiment of the present invention.

As shown in FIG. **1**, the substrate processing system of the current embodiment includes at least one substrate processing apparatus **100** operating according to a recipe defining process sequences and conditions, and a group managing apparatus **500** connected to the substrate processing apparatus **100** for exchanging data with the substrate processing apparatus **100**. The substrate processing apparatus **100** and the group managing apparatus **500** are connected through a network **400** such as a local area network (LAN) or a wide area network (WAN).

(2) Structure of Substrate Processing Apparatus

Next, with reference to FIG. **10** and FIG. **11**, the structure of the substrate processing apparatus **100** will now be explained according to the current embodiment of the present invention. FIG. **10** is a perspective diagram illustrating the substrate processing apparatus **100** according to the current embodiment of the present invention. FIG. **11** is a side sectional diagram illustrating the substrate processing apparatus **100** according to the current embodiment of the present invention. The substrate processing apparatus **100** of the current embodiment is configured as a vertical apparatus configured to perform a process such as an oxidation process, a diffusion process, or a chemical vapor deposition (CVD) process on a substrate such as a wafer.

As shown in FIG. **10** and FIG. **11**, the structure of the substrate processing apparatus **100** of the present invention includes a case **111** as a pressure-resistant vessel. At the lower side of a front wall **111***a* of the case **111**, an opening is formed as a front maintenance entrance **103** for maintenance works. At the front maintenance entrance **103**, a pair of front maintenance doors **104** is installed for closing and opening the front maintenance entrance **103**. Pods (substrate containers) **110** in which wafers (substrates) **200** are accommodated are used as carriers configured to carry wafers **200** into and out of the case **111**.

At the front wall **111***a* of the case **111**, a pod carrying entrance (substrate container carrying entrance) **112** is formed to connect the inside and outside of the case **111**. The pod carrying entrance **112** is configured to be opened and closed by a front shutter (substrate container carrying entrance opening/closing mechanism) **113**. At the front side of the pod carrying entrance **112**, a load port (substrate container stage) **114** is installed. The pods **110** are configured to be adjusted in positions when placed on the load port **114**. The pods **110** are configured to be carried onto the load port **114** by an in-process carrying device (not shown).

Near the upper center part of the inside of the case **111** in a front-to-back direction, a rotatable pod shelf (substrate container shelf) **105** is installed. A plurality of pods **110** can be stored on the rotatable pod shelf **105**. The rotatable pod shelf **105** includes a pillar **116** which is vertically installed and intermittently rotatable on a horizontal plane, and a plurality of shelf plates (substrate container stages) **117** which are radially supported at upper, middle, and lower positions of the pillar **116**. The shelf plates **117** are configured so that a plurality of pods **110** can be placed and held on each of the shelf plates **117**.

At the inside of the case **111** between the load port **114** and the rotatable pod shelf **105**, a pod carrying device (substrate container carrying device) **118** is installed. The pod carrying device **118** includes a pod elevator (substrate container elevating mechanism) **118***a* capable of moving upward and downward while holding a pod **110**, and a pod carrying mechanism (substrate container carrying mechanism) **118***b* as a carrying mechanism. The pod carrying device **118** is configured such that a pod **110** can be carried among the load port **114**, the rotatable pod shelf **105**, and pod openers (substrate container cover opening/closing mechanism) **121** by continuous operations of the pod elevator **118***a* and the pod carrying mechanism **118***b*.

At the lower inside part of the case **111**, a sub case **119** is installed in a manner such that the sub case **119** extends from about the center part to the rear part of the case **111** in a front-to-back direction. In order to carry wafers **200** into and out of the sub case **119**, a pair of wafer carrying entrances (substrate carrying entrances) **120** are formed at a front wall **119***a* of the sub case **119** in a manner such that the wafer carrying entrances **120** are vertically arranged in two stages. At the upper and lower wafer carrying entrances **120**, the pod openers **121** are installed, respectively.

Each of the pod openers **121** includes a stage **122** and a cap attachment/detachment mechanism (cover attachment/detachment mechanism) **123** configured to attach and detach a cap (cover) of a pod **110**. Each of the pod opener **121** is configured to attach and detach a cap of a pod **110** placed on the stage **122** for closing and opening a wafer entrance of the pod **110**.

A transfer chamber **124** is formed in the sub case **119** in a manner such that the transfer chamber **124** is fluidically isolated from a space where parts such as the pod carrying device **118** and the rotatable pod shelf **105** are installed. At the front region of the transfer chamber **124**, a wafer transfer mechanism (substrate transfer mechanism) **125** is installed. The wafer transfer mechanism **125** includes a wafer transfer device (substrate transfer device) **125***a* capable of rotating or straightly moving wafers **200** on a horizontal plane, and a wafer transfer device elevator (substrate transfer device elevator) **125***b* capable of moving the wafer transfer device **125***a* upward and downward. As shown in FIG. **10**, the wafer transfer device elevator **125***b* is installed between the right end part of the front region of the transfer chamber **124** of the sub case **119** and the right end part of the case **111**. The wafer transfer device **125***a* includes tweezers (substrate holders) **125***c* as stages for placing wafers **200** thereon. By continuous operations of the wafer transfer device elevator **125***b* and the

wafer transfer device **125***a*, wafers **200** can be charged into a boat (substrate holding tool) **217** or discharged from the boat **217**.

In the rear region of the transfer chamber **124**, a standby section **126** is provided so as to accommodate the boat **217** in standby state. At the upper side of the standby section **126**, a process furnace **202** is installed as a substrate processing system. The bottom side of the process furnace **202** is configured to be closed by a furnace port shutter (furnace opening/closing mechanism) **147**.

As shown in FIG. **10**, between the right end part of the standby section **126** of the sub case **119** and the right side of the case **111**, a boat elevator (substrate holding tool elevating mechanism) **115** is installed. A connecting tool such as an arm **128** is connected to an elevator base of the boat elevator **115**. A cover such a seal cap **219** is horizontally attached to the arm **128**. The seal cap **219** is configured to support the boat **217** vertically and close the bottom side of the process furnace **202**.

The boat **217** includes a plurality of holding members. The boat **217** is configured to hold a plurality of wafers **200** (for example, fifty to one hundred twenty five wafers) horizontally in a state where the centers of the wafers **200** are vertically aligned.

As shown in FIG. **10**, at the left end part of the transfer chamber **124** opposite to the wafer transfer device elevator **125***b* and the boat elevator **115**, a cleaning unit **134** configured by a supply fan and a dust filter is installed so as to supply cleaned atmosphere or inter gas as clean air **133**. Between the wafer transfer device **125***a* and the cleaning unit **134**, a notch alignment device (not shown) is installed as a substrate matching device for aligning the circumferences of wafers.

Clean air **133** blown from the cleaning unit **134** flows around the notch alignment device (not shown), the wafer transfer device **125***a*, and the boat **217** disposed at the standby section **126**. Then, the air **133** is sucked through a duct (not shown) and is exhausted to the outside of the case **111**, or the air **133** is circulated back to a suction side of the cleaning unit **134**, that is, a primary side (supply side) of the cleaning unit **134**, so as to be blown back to the transfer chamber **124** by the cleaning unit **134**.

(3) Operation of Substrate Processing Apparatus

Next, the operation of the substrate processing apparatus **100** of the current embodiment will be described with reference to FIG. **10** and FIG. **11**.

As shown in FIG. **10** and FIG. **11**, when a pod **110** is supplied to the load port **114**, the pod carrying entrance **112** is opened by moving the front shutter **113**. Then, the pod **110** is carried into the case **111** through the pod carrying entrance **112** by the pod carrying device **118**.

The pod **110** carried into the case **111** is automatically carried to the shelf plate **117** of the rotatable pod shelf **105** by the pod carrying device **118** and is temporarily stored on the shelf plate **117**, and then the pod **110** is transferred to the stage **122** of one of the pod openers **121**. Alternatively, the pod **110** carried into the case **111** may be directly transferred to the stage **122** of the pod opener **121**. At this time, the wafer carrying entrance **120** of the pod opener **121** is closed by the cap attachment/detachment mechanism **123**, and clean air **133** is circulated and filled in the transfer chamber **124**. For example, nitrogen gas is filled in the transfer chamber **124** as clean air **133** so as to keep the oxygen content of the inside of the transfer chamber **124**, for example, at 20 ppm or lower, which is much lower than the oxygen content of the inside of the case **111** kept at atmosphere.

When the pod **110** is placed on the stage **122**, the opening-side of the pod **110** is pressed by the edge of the wafer carrying entrance **120** of the front wall **119***a* of the sub case **119**, and along with this, the cap of the pod **110** is detached by the cap attachment/detachment mechanism **123**, so that the wafer entrance of the pod **110** can be opened. Thereafter, wafers **200** are picked up from the pod **110** through the wafer entrance of the pod **110** by the tweezers **125***c* of the wafer transfer device **125***a*, and after the orientations of the wafers **200** are aligned by the notch alignment device, the wafers **200** are carried to the standby section **126** located at the rear side of the transfer chamber **124** and charged into the boat **217** (wafer charging). After the wafer transfer device **125***a* charges the wafers **200** into the boat **217**, the wafer transfer device **125***a* returns to the pod **110** for charging the next wafers **200** into the boat **217**.

While wafers **200** are charged into the boat **217** from the side of one (upper or lower one) of the pod openers **121** by the wafer transfer mechanism **125**, another pod **110** is concurrently carried to and placed on the stage **122** of the other (lower or upper one) of the pod openers **121** from the rotatable pod shelf **105** by the pod carrying device **118**, and the other pod opener **121** opens the wafer entrance of the other pod **110**.

After a predetermined number of wafers **200** are charged into the boat **217**, the bottom side of the process furnace **202** closed by the furnace port shutter **147** is opened by moving the furnace port shutter **147**. Then, the boat **217** in which the wafers **200** are held is loaded into the process furnace **202** by lifting the seal cap **219** using the boat elevator **115** (boat loading).

After the loading operation, a predetermined process is performed on the wafers **200** disposed in the process furnace **202**. After the process, in approximately the reverse order to the above-described loading order except for the alignment of wafers by the notch alignment device, the boat **217** in which the processed wafers **200** are stored is carried out from the inside of the process furnace **202**, and then pods **110** in which the processed wafers **200** are accommodated are carried out of the case **111**.

(4) Structure of Process Furnace

Next, the process furnace **202** of the current embodiment will be described with reference to FIG. **12**.

FIG. **12** is a vertical sectional diagram illustrating the process furnace **202** of the substrate processing apparatus **100** according to the embodiment of the present invention.

As shown in FIG. **12**, the process furnace **202** includes a process tube **203** as a reaction tube. The process tube **203** includes an inner tube **204** as an inner reaction tube and an outer tube **205** installed outside the inner tube **204** as an outer reaction tube. The inner tube **204** is made of a heat resistant material such as quartz (SiO2) or silicon carbide (SiC) and has a cylindrical shape with opened top and bottom sides. A process chamber **201** is formed in a hollow part of the inner tube **204** so that substrates such as wafers **200** can be processed in the process chamber **201**. The process chamber **201** is configured so that the boat **217** (described later) can be accommodated in the process chamber **201**. The outer tube **205** is installed coaxially with the inner tube **204**. The outer tube **205** has a cylindrical shape having a closed top side and an opened bottom side, and the inner diameter of the outer tube **205** is larger than the outer diameter of the inner tube **204**. The outer tube **205** is made of a heat resistant material such as quartz or silicon carbide.

At the outer side of the process tube **203**, a heater **206** is installed as a heating mechanism in a manner such that the heater **206** surrounds the sidewall of the process tube **203**. The heater **206** has a cylindrical shape and is vertically installed in a state where the heater **206** is supported by a heater base **251** which is a holding plate.

At the lower side of the outer tube **205**, a manifold **209** is installed coaxially with the outer tube **205**. The manifold **209** is made of a material such as stainless steel and has a cylindrical shape with opened top and bottom sides. The manifold **209** is engaged with the bottom sides of the inner tube **204** and the outer tube **205** for supporting the inner tube **204** and the outer tube **205**. Between the manifold **209** and the outer tube **205**, an O-ring **220***a* is installed as a sealing member. The manifold **209** is supported by the heater base **251** so that the process tube **203** can be vertically installed. The process tube **203** and the manifold **209** constitute a reaction vessel.

A nozzle **230** is connected to the seal cap **219** (described later) in communication with the inside of the process chamber **201** as a gas introduction part. A gas supply pipe **232** is connected to the nozzle **230**. A process gas supply source (not shown) or an inert gas supply source (not shown) is connected to the upstream side of the gas supply pipe **232** (opposite to the nozzle **230**), and a mass flow controller (MFC) **241** used as a gas flow control device is disposed between the upstream side of the gas supply pipe **232** and the gas supply source. A gas mass flow control unit **235** is electrically connected to the MFC **241**. The gas mass flow control unit **235** is configured to control the MFC **241** so that the mass flow of gas supplied into the process chamber **201** can be adjusted to a desired level at a desired time.

At the manifold **209**, an exhaust pipe **231** is installed to exhaust the inside atmosphere of the process chamber **201**. The exhaust pipe **231** is disposed at a lower end side of a cylindrical space **250** formed between the inner tube **204** and the outer tube **205** and communicates with the cylindrical space **250**. At the downstream side of the exhaust pipe **231** (opposite to the manifold **209**), a pressure detector such as a pressure sensor **245**, a pressure adjusting device **242** configured by, for example, an auto pressure controller (APC), and a vacuum exhaust device **246** such as a vacuum pump are sequentially connected from the upstream side. A pressure control unit **236** is electrically connected to the pressure adjusting device **242** and the pressure sensor **245**. The pressure control unit **236** is configured to control the pressure adjusting device **242** based on a pressure value detected by the pressure sensor **245** so as to adjust the inside pressure of the process chamber **201** to a desired level at a desired time.

At the lower side of the manifold **209**, the seal cap **219** is installed as a furnace port cover for air-tightly closing the opened bottom side of the manifold **209**. The seal cap **219** is configured to make contact with the bottom side of the manifold **209** in a vertical direction from the lower side of the manifold **209**. The seal cap **219** is made of a metal such as stainless steel and has a disk shape. At the top surface of the seal cap **219**, an O-ring **220***b* is installed as a sealing member to make contact with the bottom side of the manifold **209**. At a center side of the seal cap **219** opposite to the process chamber **201**, a rotation mechanism **254** is installed. A shaft **255** of the rotation mechanism **254** is inserted through the seal cap **219** to support bottom side of the boat **217**.

The rotation mechanism **254** is configured to rotate wafers **200** by rotating the boat **217**. The seal cap **219** is configured to be vertically moved by an elevating mechanism such as the boat elevator **115** vertically installed outside the process tube **203**. By lifting or lowering the seal cap **219**, the boat **217** can be loaded into the process chamber **201** or unloaded from the process chamber **201**. A carrying control unit **238** is electrically connected to the rotation mechanism **254** and the boat elevator **115**. The carrying control unit **238** is configured to control the rotation mechanism **254** and the boat elevator **115** so that desired operations of the rotation mechanism **254** and the boat elevator **115** can be performed at desired times.

As described above, the boat **217** which is a substrate holding tool is configured to hold a plurality of wafers **200** in a manner such that the wafers **200** are horizontally positioned and arranged in multiple stages with the centers of the wafers **200** being aligned. The boat **217** is made of a heat resistant material such as quartz or silicon carbide. At the lower side of the boat **217**, a plurality of insulating plates **216**, which are made of a heat resistant material such as quartz or silicon carbide and have a disk shape, are horizontally disposed in multiple stages as insulating members for preventing heat transfer from the heater **206** to the manifold **209**.

Inside the process tube **203**, a temperature sensor **263** is installed as a temperature detector. A temperature control unit **237** is electrically connected to the heater **206** and the temperature sensor **263**. Based on temperature information detected by the temperature sensor **263**, the temperature control unit **237** is configured to control power supplied to the heater **206** so as to obtain desired temperature distribution in the process chamber **201** at a desired time.

The gas mass flow control unit **235**, the pressure control unit **236**, the carrying control unit **238**, and the temperature control unit **237** are electrically connected to a process control unit **239***a* configured to control the overall operation of the substrate processing apparatus **100** (hereinafter, the gas mass flow control unit **235**, the pressure control unit **236**, the carrying control unit **238**, and the temperature control unit **237** will also be referred as I/O control units). The gas mass flow control unit **235**, the pressure control unit **236**, the carrying control unit **238**, the temperature control unit **237**, and the process control unit **239***a* are configured as a substrate processing apparatus controller **240**. The structure and operation of the substrate processing apparatus controller **240** will be described later.

(5) Operation of Process Furnace

Next, as an exemplary semiconductor device manufacturing process, a method of forming a thin film on a wafer **200** by a CVD method using the above-described processing furnace **202** will be explained with reference to FIG. **12**. In the following description, each part of the substrate processing apparatus **100** is controlled by the substrate processing apparatus controller **240**.

If a plurality of wafers **200** are charged into the boat **217**, the boat elevator **115** lifts the boat **217** in which the wafers **200** are held, so that the boat **217** can be loaded into the process chamber **201** (boat loading). In this state, the bottom side of the manifold **209** is sealed by the seal cap **219** with the O-ring **220***b* being disposed therebetween.

The inside of the process chamber **201** is evacuated to a desired pressure (vacuum degree) by the vacuum exhaust device **246**. At this time, based on a pressure value measured by the pressure sensor **245**, the pressure adjusting device **242** (the degree of valve opening of the pressure adjusting device **242**) is feedback-controlled. In addition, the process chamber **201** is heated by the heater **206** to a desired temperature. At this time, based on a temperature value detected by the temperature sensor **263**, power to the heater **206** is feedback-controlled. Next, the boat **217** and the wafers **200** are rotated by the rotation mechanism **254**.

Thereafter, gas supplied from the process gas supply source while the mass flow of the gas is controlled by the MFC **241** is introduced into the process chamber **201** through the gas supply pipe **232** and the nozzle **230**. The introduced gas flows upward inside the process chamber **201** and is discharged from the opened top side of the inner tube **204** to the cylindrical space **250** where the gas is exhausted through the exhaust pipe **231**. When the gas passes through the process chamber **201**, the gas makes contact with the surfaces of

the wafers **200** so that thin films can be deposited on the surfaces of the wafers **200** by thermal CVD reaction.

After a preset time, inert gas is supplied from the inert gas supply source to replace the inside atmosphere of the process chamber **201** with the inert gas, and at this time, the pressure inside the process chamber **201** returns to atmospheric pressure.

After that, the seal cap **219** is moved down by the boat elevator **115** to open the bottom side of the manifold **209** and unload the boat **217**, in which the processed wafers **200** are held, from the process tube **203** to the outside through the opened bottom side of the manifold **209** (boat unloading). Then, the processed wafers **200** are discharged from the boat **217** and carried into pods **110** (wafer discharging).

(6) Structure of Substrate Processing Apparatus Controller

Next, with reference to FIG. **2**, the structure of the substrate processing apparatus controller **240** will now be explained according to the current embodiment. FIG. **2** is a block diagram illustrating the substrate processing apparatus **100** and the group managing apparatus **500** according to the embodiment of the present invention.

The substrate processing apparatus controller **240** includes the I/O control units (the gas mass flow control unit **235**, the pressure control unit **236**, and the temperature control unit **237**), and the process control unit **239***a* which is connected to the I/O control units in a manner such that the process control unit **239***a* can exchange data with the I/O control units. The process control unit **239***a* is configured to collect (read) data indicating the states (such as temperature, gas mass flow, and pressure) of the process furnace **202** while controlling the operation of the process furnace **202** through the I/O control units.

The substrate processing apparatus controller **240** includes a display device control unit (manipulation unit) **239** which is connected to the process control unit **239***a* in a manner such that the display device control unit **239** can exchange data with the process control unit **239***a*. A display device such as a data display unit **240***a* and an input unit **240***b* such as a keyboard are connected to the display device control unit **239**. The display device control unit **239** is configured to receive an input (such as a manipulation command) from an operator through the input unit **240***b*, and to control the data display unit **240***a* to display a screen such as a screen showing the state of the substrate processing apparatus **100** or a manipulation input screen.

In addition, the substrate processing apparatus controller **240** includes the carrying control unit **238** which is connected to the display device control unit **239** in a manner such that the carrying control unit **238** can exchange data with the display device control unit **239**, and a mechanism I/O **238***a* which is connected to the carrying control unit **238** in a manner such that the mechanism I/O **238***a* can exchange data with the carrying control unit **238**. Parts (such as the pod elevator **118***a*, the pod carrying mechanism **118***b*, the pod opener **121**, the wafer transfer mechanism **125**, and the boat elevator **115**) of the substrate processing apparatus **100** are connected to the mechanism I/O **238***a*. The carrying control unit **238** is configured to collect (read) data indicating states (such as positions, opening/closing states, and operation and wait states) of parts of the substrate processing apparatus **100** while controlling operations of the parts of the substrate processing apparatus **100** through the mechanism I/O **238***a*.

In addition, the substrate processing apparatus controller **240** includes a data storage unit **239***e* connected to the display device control unit **239**. The data storage unit **239***e* is configured to retain (store) data such as: programs for executing functions of the substrate processing apparatus controller **240**; setting data (recipe data) for performing a substrate processing process in the process furnace **202**; and data read from the I/O control units (the gas mass flow control unit **235**, the pressure control unit **236**, and the temperature control unit **237**) and the carrying control unit **238**.

In addition, the substrate processing apparatus controller **240** includes a communication control unit **239***b* connected to the display device control unit **239**. In addition, although not shown in FIG. **2**, the I/O control units (the gas mass flow control unit **235**, the pressure control unit **236**, and the temperature control unit **237**), and the carrying control unit **238** are connected in a manner such that they can exchange data directly with the communication control unit **239***b* without having to go through the process control unit **239***a* or the display device control unit **239**. In addition, the communication control unit **239***b* is connected to the group managing apparatus **500** (described later) through the network **400** in a manner such that the communication control unit **239***b* can exchange data with the group managing apparatus **500**.

In addition, it is configured such that state data (such as temperatures, gas mass flows, and pressures) of the process furnace **202** read through the I/O control units (the gas mass flow control unit **235**, the pressure control unit **236**, and the temperature control unit **237**) can be transferred to the communication control unit **239***b* through the process control unit **239***a* and the display device control unit **239**, and the communication control unit **239***b* can send the received data to the group managing apparatus **500**. In addition, it is configured such that state data (such as positions, opening/closing states, and operation and wait states) of parts of the substrate processing apparatus **100** read through the mechanism I/O **238***a* can be transferred to the communication control unit **239***b* through the carrying control unit **238** and the display device control unit **239**, and the communication control unit **239***b* can send the received data to the group managing apparatus **500**.

In addition, it is configured such that state data (such as temperatures, gas mass flows, and pressures) of the process furnace **202** read through the I/O control units can be transferred directly to the communication control unit **239***b* without going through the process control unit **239***a* and the display device control unit **239**, and the communication control unit **239***b* can send the received data to the group managing apparatus **500**. In addition, it is configured such that state data (such as positions, opening/closing states, and operation and wait states) of parts of the substrate processing apparatus **100** read through the mechanism I/O **238***a* can be transferred directly to the communication control unit **239***b* without going through the display device control unit **239**, and the communication control unit **239***b* can send the received data to the group managing apparatus **500**.

Although not shown in FIG. **2**, it is configured such the I/O control units (the gas mass flow control unit **235**, the pressure control unit **236**, and the temperature control unit **237**), and the carrying control unit **238** can exchange data directly with the group managing apparatus **500** without having to go through the process control unit **239***a*, the display device control unit **239**, and the communication control unit **239***b*. Therefore, the I/O control units can send state data (such as temperatures, gas mass flows, and pressures) of the process furnace **202** directly to the group managing apparatus **500** without going through the process control unit **239***a*, the display device control unit **239**, and the communication control unit **239***b*. In addition, it is configured such that the mechanism I/O **238***a* can send state data (such as positions, opening/closing states, and operation and wait states) of parts of the substrate processing apparatus **100** directly to the group

managing apparatus **500** without going through the display device control unit **239** and the communication control unit **239***b*.

(7) Structure of Group Managing Apparatus

Next, mainly with reference to FIG. **2** and FIG. **5** to FIG. **9**, an explanation will be given on the structure of the group managing apparatus **500** configured to exchange data with the substrate processing apparatus **100** according to the current embodiment.

FIG. **5** is a schematic diagram illustrating an exemplary basic information input screen according to the current embodiment. FIG. **6** is a schematic diagram illustrating an exemplary check item table according to the current embodiment. FIG. **7** is a schematic diagram illustrating an exemplary screen including a time-series graph according to the current embodiment. FIG. **8** is a schematic diagram illustrating a part of an exemplary abnormal information analysis table and a way of preparing a check item table based on basic information, an apparatus type based table, and the abnormal information analysis table according to the current embodiment. FIG. **9** is a schematic diagram illustrating a way of preparing a time-series graph by receiving a manipulation of selecting check item information from the check item table according to the current embodiment.

As shown in FIG. **2**, the group managing apparatus **500** is configured as a computer which includes: a control unit **501** configured by a central processing unit (CPU); a data storage unit **503** which is a storage unit including a memory having an internal share memory **502**, and a storage device such as a hard disk drive (HDD); a data display unit **505** which is a display part configured by a display device; an input unit **506** such as a keyboard; and a communication control unit **504** which is a communication device. The memory, the data storage unit **503**, the data display unit **505**, the input unit **506**, and the communication control unit **504** are configured to exchange data with the control unit **501**, for example, through internal buses. In addition, the control unit **501** has a clock function (not shown).

(Communication Control Unit)

The communication control unit **504** which is a communication device is connected to the communication control unit **239***b* of the substrate processing apparatus controller **240**, and is also connected to the I/O control units (the gas mass flow control unit **235**, the pressure control unit **236**, and the temperature control unit **237**) and the carrying control unit **238**. The communication control unit **504** is configured to receive data from the substrate processing apparatus **100** and transfer the data to the share memory **502**. Apparatus information for identifying a substrate processing apparatus **100** which generated data; recipe information that specifies a recipe executed by the substrate processing apparatus **100** at the time the data were generated; data time information indicating the time when the data were generated; and check item information that specifies check items necessary for abnormal state analysis to find out a cause of an abnormal state are added to the data delivered to the share memory **502**.

(Storage Unit)

The data storage unit **503**, which is a storage unit, is configured to store readable information such as: apparatus type information for identifying the type of a substrate processing apparatus **100** in relation to apparatus information that identifies a substrate processing apparatus **100** at which an abnormal state is generated; abnormal state information for identifying an abnormal state generated while a recipe is executed; and check item information for specifying check items necessary for analyzing a cause of an abnormal state in relation to the apparatus type information.

As shown in FIG. **8**, the data storage unit **503** is configured to store a readable apparatus type based table **503***b* in which apparatus type information (for example, CVD, ALD, diffusion, etc.) for identifying types of substrate processing apparatuses **100** is recorded in related to apparatus information (for example, Tube 01, Tube 02, Tube 03, etc.) for identifying a substrate processing apparatus **100** at which an abnormal state is generated.

In addition, the data storage unit **503** is configured to store a readable abnormal state analysis information table **503***a* containing check item information (for example, monitor value waveform superposition, monitor value average trends, monitor value maximum/minimum/average trends, monitor value waveform superposition (repetition in a batch), and trend from start to 10 seconds) for specifying check items necessary for analyzing a reason of an abnormal state in relation to abnormal state information (for example, in-surface, between-surfaces, decrease, and waste) for identifying an abnormal state generated when a recipe is executed and apparatus type information (for example, CVD, ALD, and diffusion). Furthermore, in the abnormal state analysis information table **503***a* shown in FIG. **8**, the relationship between abnormal state information and check item information, and the relationship between apparatus type information and check item information are denoted by "o" marks. That is, if the abnormal state information is "in-surface" and the apparatus type information is "CVD", items denoted by "o" marks in both the abnormal state information and the apparatus type information (in the table, items of No. 1 and No 3 to No 6) are check item information related to both the abnormal state information and the apparatus type information. In addition, in the abnormal state analysis information table **503***a* shown in FIG. **8**, check items, such as temperature, the degree of opening of MFC (or gas mass flow), pressure, the degree of opening of CKD, RF (the supply amount of power), and the content of ozonizer, which are data to be checked are defined for every check item information.

In addition, the data storage unit **503** stores data which are received by the communication control unit **504** and stored in the share memory **502** in a manner such that the data are readable in relation with apparatus information (for example, Tube 01, Tube 02, Tube 03, . . .) for identifying a substrate processing apparatus **100** that has generated the data, recipe information (for example, Recipe **500**A, Recipe **300**A, Purge, etc.) for identifying a recipe executed by the substrate processing apparatus **100** when the data were generated at the substrate processing apparatus **100**, data time information indicating the time when the data were generated; and check item information (for example, monitor value waveform superposition, monitor value average trends, monitor value maximum/minimum/average trends, monitor value waveform superposition (repetition in a batch), and trend from start to 10 seconds).

In addition, as shown in FIG. **9**, the data storage unit **503** is configured to store production history information **503***d* that specifies repeated recipes, recipe start times, and recipe end times. The production history information **503***d* is configured such that recipes executed by the substrate processing apparatus **100** are stored to the time series.

In addition, a group managing program is stored in the data storage unit **503** as an analysis support unit **511**. The group managing program is configured to be read from the memory of the data storage unit **503** and executed by the control unit **501**.

(Analysis Support Unit)

The analysis support unit **511** is configured to receive basic information **503***c* including abnormal state information and

apparatus information, acquire apparatus type information relating to the apparatus information by referring to the data storage unit **503**, extract check item information relating to both the abnormal state information and the apparatus type information, and display the extracted check item information. The analysis support unit **511** is configured to create a check item table (check sequence table) **520***b* as shown in FIG. **6**.

As shown in FIG. **5**, the analysis support unit **511** controls the data display unit **505** to display a basic information input screen **520***a* so as to receive basic information **503***c* including abnormal state information (such as in-surface, between-surfaces, decrease, and waste), apparatus information (such as Tube 01, Tube 02, Tube 03, etc.), and recipe information (such as Recipe **500**A, Recipe **300**A, and Purge, etc.). Basic information including abnormal state information, apparatus information, and recipe information is input by using the basic information input screen **520***a* and the input unit **506**. The basic information **503***c* is readably stored in the share memory **502** or the data storage unit **503** of the group managing apparatus **500**.

If the analysis support unit **511** receives an input of the basic information **503***c* including the abnormal state information, the apparatus information, and the recipe information, the analysis support unit **511** acquires apparatus type information relating to the apparatus information with reference to the apparatus type acquired table **503***b*. For example, if apparatus information input through the basic information input screen **520***a* is "Tube 01" and the apparatus type based table **503***b* shown in FIG. **8** is referred to, the analysis support unit **511** takes "CVD" as apparatus type information.

Next, the analysis support unit **511** selects check item information relating to both the abnormal state information and the apparatus type information with reference to the abnormal state analysis information table **503***a* stored in the data storage unit **503**. Then, the analysis support unit **511** displays at least one piece of the selected check item information so as to prepare a check item table **502***b* as shown in FIG. **6** and FIG. **8**.

For example, if abnormal state information input through the basic information input screen **520***a* is "in-surface" (indicating an in-surface abnormal state), "CVD" is extracted as apparatus type information, and the abnormal state analysis information table **503***a* shown in FIG. **8** is referred to, the analysis support unit **511** extracts items (items of No 1 and No 3 to No 6 in the table of FIG. **8**) indicated by o marks in both the abnormal state information and the apparatus type information as check item information relating to both the abnormal state information and the apparatus type information. That is, the analysis support unit **511** extracts "monitor value waveform superposition" of temperature, "monitor value average trend" of temperature, "monitor value maximum/minimum/average trends" of MFC, "monitor value maximum/minimum/average trends" of pressure, "monitor value waveform superposition" of CKD opening degree that indicates the degree of opening of a valve, and "monitor value maximum/minimum/average trends" of CKD opening degree. Then, the analysis support unit **511** displays the extracted check item information so as to prepare a check item table **502***b* as shown in FIG. **6** and FIG. **8**. The analysis support unit **511** displays the check item table **502***b* on the data display unit **505**.

In addition, the analysis support unit **511** is configured to receive a manipulation of selecting check item information from the check item table **502***b* and read data relating to both the recipe information and the check item information from the data storage unit **503**. Then, based on data time information, the analysis support unit **511** draws a time-series superposition graph by using the read data while arranging recipe start times so as to provide a time-series graph **520***c* as shown in FIG. **7**.

Specifically, if the check item table **502***b* shown in FIG. **6** is displayed on the data display unit **505** and "monitor value waveform superposition" of temperature is selected through the input unit **506** as check item information (for example, in FIG. **6**, check item information corresponding to No. 1 is selected by clicking), the analysis support unit **511** receives the selecting manipulation.

After receiving the selection manipulation, the analysis support unit **511** acquires recipe information such as "Recipe **500**A" by referring to the basic information **503***c*.

After acquiring the recipe information, the analysis support unit **511** searches the production history information **503***d* shown in FIG. **9** so as to determine whether the recipe information acquired from the basic information **503***c* is included in the production history information **503***d*. For example, the searching is performed on a plurality of recipes included in the production history information **503***d* in a reverse order from the latest recipe to the oldest recipe.

Then, if the analysis support unit **511** detects the recipe information of the basic information **503***c* from the production history information **503***d*, the analysis support unit **511** acquires the start and end times of the recipe information (for example, the start and end times of "Recipe **500**A").

Then, the analysis support unit **511** reads data from the data storage unit **503** which are generated between the start and end times and relate to both the recipe information of "Recipe **500**A" and the check item information of "monitor value waveform superposition" (for example, the analysis support unit **511** reads temperature data generated during the "Recipe **500**A" was performed).

In addition, the analysis support unit **511** is configured to read data repeatedly so that data corresponding to a predetermined number of recipe execution can be read (for example, the analysis support unit **511** reads data in a reverse order from the latest execution of the recipe to the 10^{th} execution of the recipe).

In addition, the analysis support unit **511** is configured to acquire data not only from the substrate processing apparatus **100** where an abnormal state is generated but also from another substrate processing apparatus **100** distant from the substrate processing apparatus **100**. That is, if the analysis support unit **511** detects the recipe information of the basic information **503***c* from a production history information **503***d* of the other substrate processing apparatus **100**, the analysis support unit **511** acquires start and end times of the recipe information from the other production history information **503***d* and reads data from the data storage unit **503** which are generated between the start and end times and relate to both the recipe information and check item information.

Then, based on data time information relating to the read data, the analysis support unit **511** draws a time-series superposition graph while arranging recipe start times so as to provide a time-series graph **520***c* as shown in FIG. **7**. Thereafter, the analysis support unit **511** displays the time-series graph **520***c* on the data display unit **505**.

In addition, if display of the time-series graph **520***c* on the data display unit **505** is completed or a screen on which the time-series graph **520***c* is displayed is closed by the data display unit **505**, the analysis support unit **511** adds a check mark on the check item table **520***b* to indicate the fact. For example, referring to FIG. **6**, display of a time-series graph **520***c* relating to "monitor value average trend" of No. 2, and

display of a time-series graph **520***c* relating to "monitor value maximum/minimum/average trends" of No. 3 have been completed.

In addition, if the analysis support unit **511** receives a check result output request (for example, if a comma-separated values (CSV) button of a screen displaying the time-series graph **520***c* is pressed) after the time-series graph **520***c* is drawn, the analysis support unit **511** outputs data included in the time-series graph **520***c* in the form of CSV.

(8) Operation of Group Managing Apparatus

Next, with reference to FIG. **3** and FIG. **4**, the operation of the group managing apparatus **500** will be explained according to the current embodiment. FIG. **3** is a flowchart illustrating exemplary operations of the group managing apparatus **500** for preparing and displaying a check item table according to the current embodiment. FIG. **4** is a flowchart illustrating exemplary operations of the group managing apparatus **500** for preparing and displaying a time-series graph according to the current embodiment. Such operations are performed as operations of a semiconductor device manufacturing process.

(Data Receiving Process S**100**)

First, the communication control unit **504** of the group managing apparatus **500** receives data indicating recipe progress states or the states of a substrate processing apparatus **100** from the substrate processing apparatus **100**. The communication control unit **504** transfers the data received from the substrate processing apparatus **100** to the share memory **502**. Apparatus information that specifies a substrate processing apparatus **100** which generated data; recipe information that specifies a recipe executed by the substrate processing apparatus **100** at the time the data were generated; data time information that specifies the time when the data were generated; and check item information that specifies check items necessary for abnormal state analysis to find out a cause of an abnormal state are added to the data transferred to the share memory **502**.

(Data Storing Process S**110**)

Next, the data storage unit **503** of the group managing apparatus **500** stores the data of the share memory **502** in a manner such that the data can be read in relation with the apparatus information that identifies the substrate processing apparatus **100** which generated data; the recipe information that specifies a recipe executed by the substrate processing apparatus **100** at the time the data were generated; the data time information that specifies the time when the data were generated; and the check item information that specifies check items necessary for abnormal state analysis to find out a cause of an abnormal state.

(Basic Information Input Screen Displaying Process S**120**)

Next, the analysis support unit **511** of the group managing apparatus **500** controls the data display unit **505** to display a basic information input screen **520***a* so as to receive basic information **503***c* including abnormal state information (such as in-surface, between-surfaces, decrease, and waste), apparatus information (such as Tube 01, Tube 02, Tube 03, etc.), and recipe information (such as Recipe **500**A, Recipe **300**A, Purge, etc.).

(Basic Information Input Process S**130**)

Next, basic information **503***c* including abnormal state information, apparatus information, and recipe information is input by using the basic information input screen **520***a* and the input unit **506**. The basic information **503***c* is readably stored in the share memory **502** or the data storage unit **503** of the group managing apparatus **500**.

(Apparatus Type Information Acquiring Process S**140**)

If the analysis support unit **511** receives the input of the basic information **503***c* including the abnormal state information, the apparatus information, and the recipe information is input, the analysis support unit **511** acquires apparatus type information relating to apparatus information from the apparatus type acquired table **503***b*. For example, if "Tube 01" is input as apparatus information through the basic information input screen **520***a*, the analysis support unit **511** takes "CVD" as apparatus type information by referring to the apparatus type based table **503***b* exemplarily shown in FIG. **8**.

(Check Item Table Preparing Process S**150**)

Next, the analysis support unit **511** extracts check item information relating to both the abnormal state information and the apparatus type information with reference to the abnormal state analysis information table **503***a* stored in the data storage unit **503**. Then, the analysis support unit **511** displays the extracted check item information and prepares a check item table **520***b* as shown in FIG. **6** and FIG. **8**.

(Check Item Table Displaying Process S**160**)

The analysis support unit **511** displays the check item table **520***b* on the data display unit **505**.

(Process S**210** of Receiving Manipulation of Selecting Check Item Information)

Next, the analysis support unit **511** receives a selection manipulation of check item information from the check item table **520***b* through the input unit **506** (for example, the analysis support unit **511** receives a selection manipulation such as clicking of check item information corresponding to No. 1 in FIG. **6** or FIG. **8**).

(Recipe Information Acquiring Process S**220**)

Then, the analysis support unit **511** acquires recipe information such as "Recipe **500**A" from the basic information **503***c*.

(Process S**230** of Retrieving Recipe from Production History Information)

Thereafter, the analysis support unit **511** searches production history information **503***d* shown in FIG. **9** so as to determine whether the recipe information of the basic information **503***c* is included in the production history information **503***d*. For example, the searching is performed on a plurality of recipes included in the production history information **503***d* in a reverse order from the latest recipe to the oldest recipe.

(Process S**240** of Acquiring Recipe Start and End Times)

Then, if the analysis support unit **511** detects the recipe information of the basic information **503***c* from the production history information **503***d*, the analysis support unit **511** acquires start and end times of the recipe information (for example, the analysis support unit **511** acquires start and end times of "Recipe **500**A").

(Process S**250** of Reading Corresponding Data)

Then, the analysis support unit **511** reads data from the data storage unit **503** which generated between the start and end times and relate to both the recipe information of "Recipe **500**A" and the check item information of "monitor value waveform superposition" (for example, the analysis support unit **511** reads temperature data generated during the "Recipe **500**A" was performed).

In addition, if the recipe identified by the recipe information was performed a plurality of times in the production history information **503***d*, the analysis support unit **511** reads data corresponding to a predetermined execution number (for example, the analysis support unit **511** reads data in a reverse order from the latest execution of the recipe to the 10^{th} execution of the recipe). That is, the analysis support unit **511** repeats operations S**230** to S**240** predetermined times.

(Time-Series Graph Preparing Process S**260**)

Then, based on data time information relating to the read data, the analysis support unit **511** draws a time-series superposition graph while arranging recipe start times so as to

provide a time-series graph **520***c* as shown in FIG. **7**. Thereafter, the analysis support unit **511** displays the time-series graph **520***c* on the data display unit **505**.

(Check Mark Displaying Process S**270**)

Then, if display of the time-series graph **520***c* on the data display unit **505** is completed or a screen on which the time-series graph **520***c* is displayed is closed by the data display unit **505**, the analysis support unit **511** adds a check mark on the check item table **520***b* to indicate the fact. In addition, if the analysis support unit **511** receives a check result output request (for example, if a CSV button of a screen displaying the time-series graph **520***c* is pressed) after the time-series graph **520***c* is drawn, the analysis support unit **511** outputs data included in the time-series graph **520***c* in the form of CSV.

(9) Effects of the Embodiment

According to the current embodiment, one or more of the following effects can be attained.

(a) According to the current embodiment, the analysis support unit **511** is configured to extract check item information relating to both abnormal state information and apparatus type information with reference to an abnormal state analysis information table **503***a*, and display the extracted check item information so as to prepare and display a check item table **520***b*. Since the check item table **520***b* is prepared in this way, a maintenance engineer can know check items necessary for abnormal state analysis without omitting any of them, and thus abnormal state analysis can be correctly performed. In addition, since check item information relating to both abnormal state information and apparatus type information is only included in the check item table **520***b*, a maintenance engineer may not inspect unnecessary check items, and thus abnormal state analysis can be carried out without wasting time. That is, abnormal state analysis can be quickly and correctly conducted independent of the skill of a maintenance engineer.

(b) According to the current embodiment, the analysis support unit **511** is configured to receive a manipulation of selecting check item information from the check item table **502***b*, read data relating to both recipe information and check item information from the data storage unit **503**, draw a time-series superposition graph based on data time information by using the read data while arranging recipe start times so as to display a time-series superposition graph **520***c* on the data display unit **505**. That is, if a maintenance engineer selects check item information from the check item table **520***b*, a time-series graph **520***c* can be automatically displayed. Owing to this configuration, a maintenance engineer can perform abnormal state analysis with less difficulty.

(c) According to the current embodiment, when the analysis support unit **511** draws a time-series graph **520***c*, the analysis support unit **511** can read data repeatedly so that data corresponding to a predetermined number of recipe execution can be read (for example, the analysis support unit **511** may read data in a reverse order from the latest execution of a recipe to the 10th execution of the recipe). Then, based on data time information relating to the read data, the analysis support unit **511** can draw a time-series superposition graph while arranging recipe start times so as to provide a time-series graph **520***c* as shown in FIG. **7** and display the time-series graph **520***c* on the data display unit **505**. Owing to this, a maintenance engineer can perform abnormal state analysis with less difficulty in acquiring data.

(d) According to the current embodiment, when the analysis support unit **511** draws a time-series graph **520***c*, the analysis support unit **511** can acquire data not only from the substrate processing apparatus **100** where an abnormal state is generated but also from another substrate processing apparatus **100** distant from the substrate processing apparatus **100**. That is, if the analysis support unit **511** detects the recipe information of the basic information **503***c* from a production history information **503***d* of the other substrate processing apparatus **100**, the analysis support unit **511** acquires start and end times of the recipe information from the other production history information **503***d* and reads data from the data storage unit **503** which are generated between the acquired start and end times and relate to both the recipe information and check item information. Then, based on data time information relating to the read data, the analysis support unit **511** can draw a time-series superposition graph while arranging recipe start times so as to provide a time-series graph **520***c* as shown in FIG. **7** and display the time-series graph **520***c* on the data display unit **505**. Owing to this, a maintenance engineer can perform abnormal state analysis with less difficulty in acquiring data.

(e) According to the current embodiment, the analysis support unit **511** is configured to receive an input of basic information **503***c* including abnormal state information, and acquire apparatus type information relating to apparatus information from an apparatus type based table **503***b*. Therefore, a maintenance engineer can know sufficient check items for abnormal state analysis without having to find out the type of an apparatus. That is, abnormal state analysis can be quickly and correctly conducted independent of the skill of a maintenance engineer.

(f) According to the current embodiment, if display of a time-series graph **520***c* on the data display unit **505** is completed or a screen on which the time-series graph **520***c* is displayed is closed by the data display unit **505**, the analysis support unit **511** adds a check mark on the check item table **520***b* to indicate the fact. Owing to this, independent of the skill of a maintenance engineer, abnormal state analysis can be correctly conducted without omission.

(g) According to the current embodiment, if the analysis support unit **511** receives a check result output request (for example, if a CSV button of a screen displaying a time-series graph **520***c* is pressed) after a time-series graph **520***c* is drawn, the analysis support unit **511** outputs data included in the time-series graph **520***c* in the form of CSV. Owing to this, a maintenance engineer can perform abnormal state analysis with less difficulty in acquiring data.

Other Embodiments of the Present Invention

The present invention is not limited to the case where the substrate processing apparatus **100** and the group managing apparatus **500** are disposed on the same floor (in the same cleaning room). For example, the substrate processing apparatus **100** may be disposed in a cleaning room, and the group managing apparatus **500** may be disposed in an office (a floor different from the floor of the cleaning room). Then, recipe progress states or the states of the substrate processing apparatus **100** may be remotely monitored.

As well as a chemical vapor deposition (CVD) film-forming process, an atomic layer deposition (ALD) film-forming process, and a physical vapor deposition (PVD) film-forming process, the present invention may be suitably applied to other processes such as a diffusion process, an annealing process, an oxidizing process, a nitriding process, and a lithograph process. In addition, as well as a thin film forming apparatus, the present invention may be suitably applied to other substrate processing apparatuses such as an annealing

apparatus, an oxidizing apparatus, a nitriding apparatus, an exposure apparatus, a coating apparatus, a drying apparatus, and a heating apparatus.

The present invention is not limited to the substrate processing apparatus of the current embodiment which is a semiconductor manufacturing apparatus configured to process a substrate (wafer). For example, the present invention may be suitably applied to other substrate processing apparatuses such as a liquid crystal display (LCD) manufacturing apparatus configured to process a glass substrate.

According to the substrate processing system of the present invention, a maintenance engineer can analyze an abnormal state with less difficulty in a rapid and correct manner independent of his/her skill.

While embodiments of the present invention have been described in detail, the present invention is not limited thereto, and many different embodiments are possible within the scope and spirit of the present invention.

<Supplementary Note>

The present invention also includes the following embodiments.

According to an embodiment of the present invention, there is provided a substrate processing system comprising: a substrate processing apparatus configured to operate according to a recipe defining a process sequence and process conditions; and a group managing apparatus connected to the substrate processing apparatus,

wherein the group managing apparatus comprises:

a storage unit configured to store readable apparatus type information for identifying a type of the substrate processing apparatus in relation to apparatus information used to identify the substrate processing apparatus for a case where an abnormal state occurs at the substrate processing apparatus, and readable check item information for specifying a check item necessary for analyzing a cause of the abnormal state in relation to the apparatus type information and abnormal state information for identifying an abnormal state occurring when the recipe is executed; and

an analysis support unit configured to receive basic information comprising the abnormal state information and the apparatus information, acquire apparatus type information relating to the apparatus information by referring to the storage unit, extract check item information relating to both the abnormal state information and the apparatus type information, and display the extracted check item information to prepare a check item table.

According to another embodiment of the present invention, there is provided a substrate processing system comprising: a substrate processing apparatus configured to operate according to a recipe defining a process sequence and process conditions; and a group managing apparatus connected to the substrate processing apparatus,

wherein the group managing apparatus comprises:

a communication unit configured to receive data indicating a recipe progress state or a state of the substrate processing apparatus from the substrate processing apparatus;

a storage unit configured to store a readable apparatus type based table containing apparatus type information for identifying a type of the substrate processing apparatus in relation to apparatus information used to identify the substrate processing apparatus for a case where an abnormal state occurs at the substrate processing apparatus, and a readable abnormal state analysis information table containing check item information for specifying a check item necessary for analyzing a cause of the abnormal state in relation to the apparatus type information and abnormal state information for identifying an abnormal state occurring when the recipe is executed; and

an analysis support unit configured to receive basic information comprising the abnormal state information and the apparatus information, acquire apparatus type information relating to the apparatus information by referring to the apparatus type based table, extract check item information relating to both the abnormal state information and the apparatus type information by referring to the abnormal state analysis information table, and display the extracted check item information to prepare a check item table.

According to another embodiment of the present invention, there is provided a substrate processing system comprising: a substrate processing apparatus configured to operate according to a recipe defining a process sequence and process conditions; and a group managing apparatus connected to the substrate processing apparatus,

wherein the group managing apparatus comprises:

a communication unit configured to receive data indicating a recipe progress state or a state of the substrate processing apparatus from the substrate processing apparatus;

a storage unit configured to store a readable apparatus type based table containing apparatus type information for identifying a type of the substrate processing apparatus in relation to apparatus information used to identify the substrate processing apparatus for a case where an abnormal state occurs at the substrate processing apparatus, and a readable abnormal state analysis information table containing check item information for specifying a check item necessary for analyzing a cause of the abnormal state in relation to the apparatus type information and abnormal state information for identifying an abnormal state occurring when the recipe is executed, wherein the data received by the communication unit are readably stored in the storage unit in relation to recipe information for identifying the recipe executed by the substrate processing apparatus when the data are generated, time information specifying a generation time of the data, and the check item information; and

an analysis support unit configured to receive basic information comprising the abnormal state information, the apparatus information, and the recipe information, acquire apparatus type information relating to the apparatus information by referring to the apparatus type based table, extract check item information relating to both the abnormal state information and the apparatus type information by referring to the abnormal state analysis information table, and display the extracted check item information to prepare a check item table,

wherein the analysis support unit is configured to receive a selection manipulation of check item information from the check item table, read the data relating to both the recipe information and the check item information, and draw a time-series superposition graph based on the time information of the data while arranging start times of the recipe so as to provide a time-series graph.

Preferably, the storage unit may store readable recipe information for identifying a repeatedly executed recipe, and readable production history information for specifying start and end times of the recipe, and

the analysis support unit may receive a selection manipulation of check item information from the check item table, acquire the start and end times of the recipe from the production history information, read the data from the storage unit which are generated between the start and end times of the recipe and are related to both the recipe information and the check item information, and draw a time-series superposition graph based on the time information of the data while arranging start times of the recipe so as to provide a time-series graph.

Preferably, the analysis support unit may display the time-series graph on a display unit, and if displaying of the time-series graph on the display unit is completed, the analysis support unit may add a check mark on the check item table to indicate completion of the displaying of the time-series graph.

Preferably, if the analysis support unit receives a check result output request after the time-series graph is drawn, the analysis support unit may output the data constituting the time-series graph.

According to another aspect of the present invention, there is provided a group managing apparatus connected to a substrate processing apparatus which is configured to operate according to a recipe defining a process sequence and process conditions, the group managing apparatus comprising:

a storage unit configured to store readable apparatus type information for identifying a type of the substrate processing apparatus in relation to apparatus information used to identify the substrate processing apparatus for a case where an abnormal state occurs at the substrate processing apparatus, and readable check item information for specifying a check item necessary for analyzing a cause of the abnormal state in relation to the apparatus type information and abnormal state information for identifying an abnormal state occurring when the recipe is executed; and

an analysis support unit configured to receive basic information comprising the abnormal state information and the apparatus information, acquire apparatus type information relating to the apparatus information by referring to the storage unit, extract check item information relating to both the abnormal state information and the apparatus type information by referring to the storage unit, and display the extracted check item information to prepare a check item table.

According to another embodiment of the present invention, there is provided a group managing apparatus connected to a substrate processing apparatus which is configured to operate according to a recipe defining a process sequence and process conditions, the group managing apparatus comprising:

a communication unit configured to receive data indicating a recipe progress state or a state of the substrate processing apparatus from the substrate processing apparatus;

a storage unit configured to store a readable apparatus type based table containing apparatus type information for identifying a type of the substrate processing apparatus in relation to apparatus information used to identify the substrate processing apparatus for a case where an abnormal state occurs at the substrate processing apparatus, and a readable abnormal state analysis information table containing check item information for specifying a check item necessary for analyzing a cause of the abnormal state in relation to the apparatus type information and abnormal state information for identifying an abnormal state occurring when the recipe is executed; and

an analysis support unit configured to receive basic information comprising the abnormal state information and the apparatus information, acquire apparatus type information relating to the apparatus information by referring to the apparatus type based table, extract check item information relating to both the abnormal state information and the apparatus type information by referring to the abnormal state analysis information table, and display the extracted check item information to prepare a check item table.

According to another embodiment of the present invention, there is provided a method of analyzing information of a substrate processing system including: a substrate processing apparatus configured to operate according to a recipe defining a process sequence and process conditions; and a group managing apparatus connected to the substrate processing apparatus,

the method comprising:

a storage unit of the group managing apparatus storing readable apparatus type information for identifying a type of the substrate processing apparatus in relation to apparatus information used to identify the substrate processing apparatus for a case where an abnormal state occurs at the substrate processing apparatus, and readable check item information for specifying a check item necessary for analyzing a cause of the abnormal state in relation to the apparatus type information and abnormal state information for identifying an abnormal state occurring when the recipe is executed;

a communication unit of the group managing apparatus receiving data indicating a recipe progress state or a state of the substrate processing apparatus from the substrate processing apparatus; and

an analysis support unit of the group managing apparatus receiving basic information comprising the abnormal state information and the apparatus information, acquiring apparatus type information relating to the apparatus information by referring to the storage unit, extracting check item information relating to both the abnormal state information and the apparatus type information by referring to the storage unit, and displaying the extracted check item information to prepare a check item table.

What is claimed is:

1. A substrate processing system comprising:

a substrate processing apparatus configured to operate according to a recipe defining a process sequence and process conditions; and

a group managing apparatus connected to the substrate processing apparatus,

wherein the group managing apparatus comprises:

a storage unit configured to store apparatus type information specifying a type of the substrate processing apparatus in an abnormal state in relation to apparatus information indicating the substrate processing apparatus is in the abnormal state, and check item information specifying a check item necessary for analyzing a cause of the abnormal state related to the apparatus type information and abnormal state information specifying the abnormal state occurring during execution of the recipe; and

an analysis support unit configured to receive basic information comprising the abnormal state information and the apparatus information, acquire the apparatus type information related to the apparatus information by referring to the storage unit, extract the check item information related to the apparatus type information and the abnormal state information, and prepare a check item table comprising the extracted check item information.

2. The substrate processing system of claim **1**, further comprising:

a communication unit configured to receive data indicating a progress state of the recipe or a state of the substrate processing apparatus from the substrate processing apparatus,

wherein the data received by the communication unit is stored in the storage unit in relation to recipe information specifying the recipe executed by the substrate processing apparatus when the data is generated, time information specifying a generation time of the data, and the check item information.

3. The substrate processing system of claim **2**, wherein the group managing apparatus stores recipe information specify-

ing a repeatedly executed recipe, and production history information specifying at least a start time and an end times of the recipe.

4. The substrate processing system of claim **3**, wherein the group managing apparatus is configured to:

acquire the start time and the end time of the recipe from the production history information;

read the data generated during a period between the start time and the end times of the recipe and related to the recipe information and the check item information from the storage unit; and

draw a time-series graph from the data based on time information specifying a generation time of the data by arranging the start times of the recipe.

5. The substrate processing system of claim **4**, wherein the group managing apparatus displays a check mark to indicate completion of displaying of the time-series graph when the displaying of the time-series graph is completed.

6. A group managing apparatus connected to a substrate processing apparatus configured to operate according to a recipe defining a process sequence and process conditions, the group managing apparatus comprising:

a storage unit configured to store apparatus type information specifying a type of the substrate processing apparatus in an abnormal state in relation to apparatus information indicating the substrate processing apparatus is in the abnormal state, and check item information specifying a check item necessary for analyzing a cause of the abnormal state related to the apparatus type information and abnormal state information specifying in the abnormal state occurring during execution of the recipe; and

an analysis support unit configured to receive basic information comprising the abnormal state information and the apparatus information, acquire the apparatus type information related to the apparatus information by referring to the storage unit, extract the check item information related to the apparatus type information and the abnormal state information, and prepare a check item table comprising the extracted check item information.

7. The group managing apparatus of claim **6**, further comprising:

a communication unit configured to receive data indicating a progress state of the recipe or a state of the substrate processing apparatus from the substrate processing apparatus,

wherein the data received by the communication unit is stored in the storage unit in relation to recipe information specifying the recipe executed by the substrate processing apparatus when the data is generated, time information specifying a generation time of the data, and the check item information.

8. The group managing apparatus of claim **7**, wherein the group managing apparatus stores recipe information specifying a repeatedly executed recipe, and production history information specifying at least a start time and an end times of the recipe.

9. The group managing apparatus of claim **8**, wherein the group managing apparatus is configured to:

acquire the start time and the end time of the recipe from the production history information;

read the data generated during a period between the start time and the end times of the recipe and related to the recipe information and the check item information from the storage unit; and

draw a time-series graph from the data based on time information specifying a generation time of the data by arranging the start times of the recipe.

10. The group managing apparatus of claim **9**, wherein the group managing apparatus displays a check mark to indicate completion of the displaying of the time-series graph when displaying of the time-series graph is completed.

11. A method of analyzing an abnormal state of a substrate processing apparatus, the method comprising:

storing apparatus type information specifying a type of the substrate processing apparatus in an abnormal state in relation to apparatus information indicating the substrate processing apparatus is in the abnormal state and check item information specifying a check item necessary for analyzing a cause of the abnormal state related to the apparatus type information and abnormal state information specifying the abnormal state occurring during execution of the recipe;

receiving basic information comprising the abnormal state information and the apparatus information;

acquiring the apparatus type information related to the apparatus information by referring to the storage unit;

extracting the check item information related to the apparatus type information and the abnormal state information; and

preparing a check item table comprising the extracted check item information.

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